THE MECHANICS' MAGAZINE, MUSEUM, Register, Journal, AND GAZETTE,

JANUARY 7th.—JULY 24th, 1843.

VOL. XXXVIII.

"It is better for the interests of science that we rather go about it, not with a single candle, but by means of a great branching candlestick of lights."

BACON.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1013.] SATURDAY, JANUARY 7, 1843. [Price 3*d.*]

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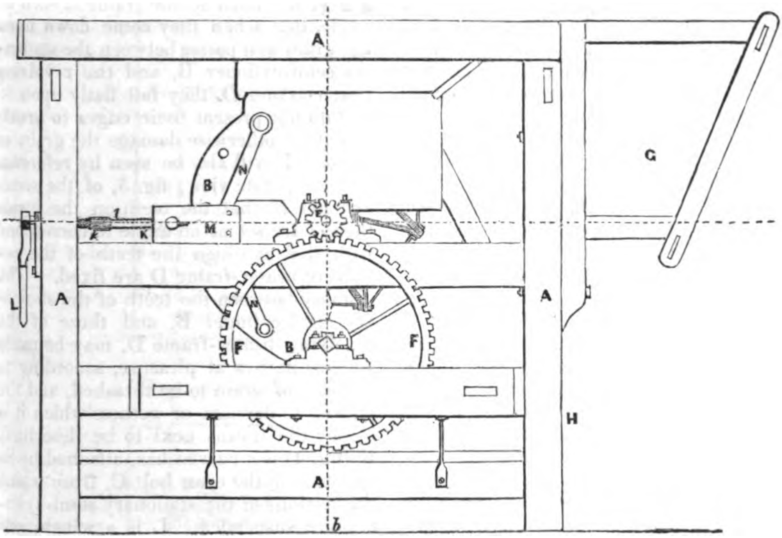
DRY'S PATENT THRASHING MACHINE.

Fig. 1.



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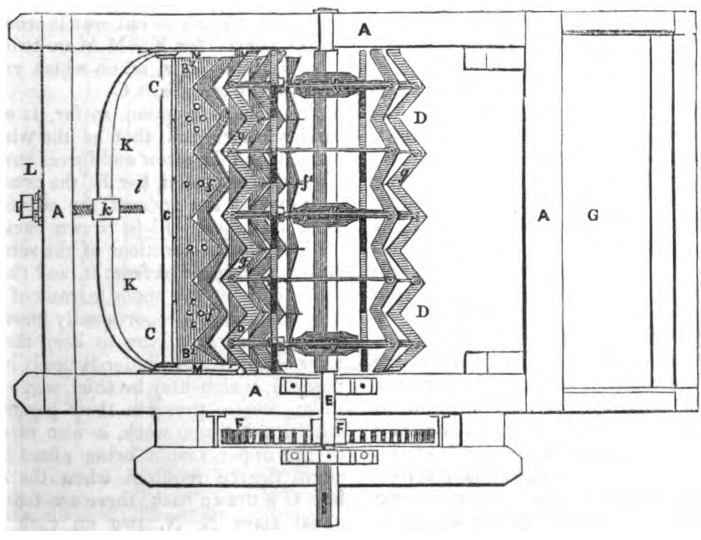


DRY'S PATENT THRASHING MACHINE.

[Patent dated August 2, 1842.]

The thrashing machine represented in the accompanying engravings, though but recently patented, and only just specified, is already, we are informed, coming into extensive use in the North of England. It is certainly, by far, the most effectual, simple, and easily managed of any yet produced. Fig. 1 is a side elevation of the machine; fig. 2 is an end elevation; fig. 3, a transverse section, through the line *a b*, of fig. 1, and fig. 4, a horizontal section, through the line *c d*, of fig. 1. A A A A is the framework of the machine; B is a semi-cylinder, represented separately in fig. 5, which is divided into two sections, B^1 and B^2, each of which is suspended, independently of the other, by eye bolts from the cross bolt C. Both sections present, on the inside, regular rows of teeth *f f f*, of a triangular form, supported by transverse stays, or ties, f^2 f^2; but in the upper section, the spaces between the rows of teeth and the stays are closed; while, in the lower, these spaces are left open. By means to be presently explained, both these sections are made perfectly fixed and stationary, when the machine is in action, and in that state they have the appearance of, and form, in effect, one entire semi-cylinder. D is a revolving beater-frame, shown separately in figs. 6 and 7, (the former being a bird's-eye-view, and the latter an end view,) which carries rows of teeth or beaters, *g g g*, shaped similarly to the teeth, *f f*, of the stationary semi-cylinder B, and taking into the interstices between them. E is a pinion, fixed on the end of the axis of the revolving beater-frame D. F is a cog wheel, which takes into the pinion E, and which, being connected by its axis with any primary moving power, as horse power, or steam power, gives motion to the whole machine. G is a stage, or platform, from which the grain to be thrashed is laid by hand on an inclined feeding board G^2, whence it falls between the teeth of the revolving beater-frame and those of the stationary semi-cylinder. The grain, as it is thrashed out, falls through the open interstices of the lower section B^2 of the stationary semi-cylinder, and is received on the floor of the machine, while the straw is carried round by the action of the revolving beater-frame D, and thrown out into the vacant space, H, behind. From the separate views (figs. 6 and 7) given of the revolving beater-frame, it will be seen that the triangularly-shaped beaters, *g g g*, are fixed to the frame at such an angle, that when they come down upon the grain as it passes between the stationary semi-cylinder B, and the revolving beater-frame D, they fall flatly upon it, and do not present their edges to break, or cut, or otherwise damage the grain or straw. It will also be seen by reference to the separate view, fig. 5, of the semi-cylinder B, that the teeth on the inside thereof are set at an angle to correspond with that at which the teeth of the revolving beater-frame D are fixed. The distance between the teeth of the stationary semi-cylinder B, and those of the revolving beater-frame D, may be made wide or narrow at pleasure, according to the sort of grain to be thrashed, and the state as to dryness or wetness which it is in, by the means next to be described. K (fig. 4) is a curved bar, attached by its two ends to the cross bolt C, from which the sections of the stationary semi-cylinder are suspended. L is a winch, one arm of which passes through a bearing *k*, at the end of the frame work A A, and terminates in a male screw *l*, which takes into a female screw cut out in the head of the curved bar K. M M are two bearings in the slots *m m*, on which rest the ends of the cross bolt C.

From the description, so far, it will be readily understood, that as the winch is turned, and the screw end forced inwards, through the curved bar K, the cross bolt C, to which the ends of the curved bar K are attached, will be drawn back, and with it the two sections of the semi-cylinder B, suspended from it, and that the space between the opposite rows of teeth will be thereby proportionally increased, and *vice versa*. Now to keep the sections of the semi-cylinder B steady in any position, which may be thus assigned to them, and to preserve their parallelism within the frame work, as also to allow of the upper section being raised to the slight degree required when the cross bolt C is drawn back, there are four diagonal stays N N, two on each side,

Fig. 2.

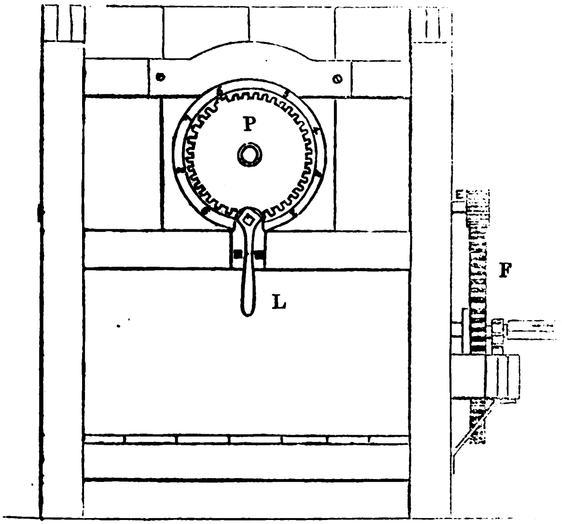


Fig. 3.

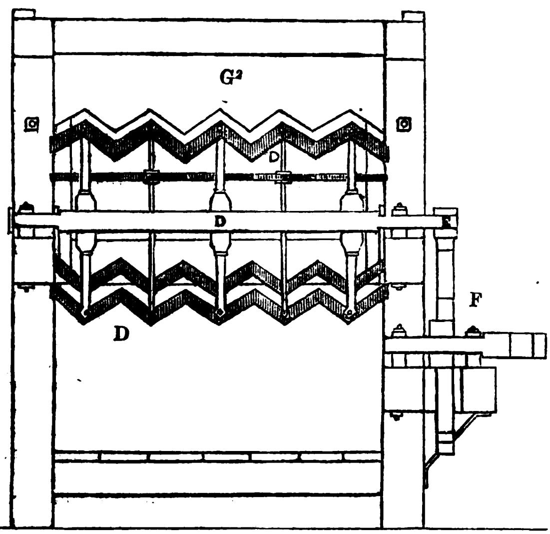


Fig. 5.

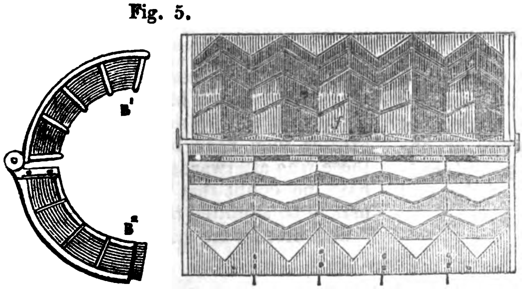


Fig. 7.

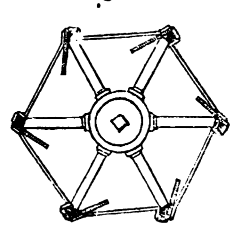
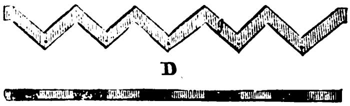


Fig. 6.



which pass from the sides of the sections B^1 and B^2, to the insides of the bearings M M, and are secured at each point by screws, on which they turn freely, so that whatever is the position given to the cross bolt, the thrust of the diagonal stays on one side, and the opposing force of the screw *l* on the other, will keep it for the time fixed in that position. On the screw arm of the winch L, there is a small pinion O, which takes into a circular toothed plate P, fixed on the end of the machine, on the centre of which plate is fixed the centre of a larger plate, which the inventor calls the index plate, the rim of which is divided into any number of equal parts, say from 1 to 10 inclusive, as shown in fig. 2. The purpose of these arrangements is to enable the owner or user of the machine instantly to ascertain, by outside inspection, whether the semi-cylinder B, and the revolving beater-frame D, are at the distance from each other most proper for the sort of grain which is in the course of being thrashed. Thus, supposing fig. 1 were to indicate when the pointer of the toothed plate P is opposite to it, that the teeth of the cylinder and beater-frame are all but in contact with one another, 2, 3, and 4 would indicate, that they are one, two, or three degrees more removed from one another. Or again, supposing that it has been found, by repeated trials, that the best distance for thrashing wheat, in a dry state, is when the pointer of the toothed plate P is opposite fig. 3, the owner, or user, has for ever after, when thrashing such wheat, only to see that the index plate is in that position, and so of all other sorts of grain. The inventor states, that though the teeth, as well of the stationary semi-cylinder as of the revolving beater-frame have been directed to be set at such an angle as that they shall act or press flatly against the grain to be thrashed; yet, that he does not confine himself to any one angle, but claims a right to use any angle or angles at which they can be placed consistently with the production of the said effect.

THE "NOVELTY" STEAM-SHIP.

Sir,—Public attention having been recently attracted by the performances of this vessel, which you are aware has been fitted by me (under my patent) with a screw propeller worked direct from the engines, I will make no apology for offering a communication on this interesting subject through the medium of your pages. The results are so extraordinary and incredible, that, with a view of drawing public notice more forcibly to the important facts I have developed, I inserted the following challenge in the *Times* of the 15th December:—

"Steam Navigation.—The owner of the *Novelty* steam-ship, 12 years A 1, 328 tons, 25 horses' power, challenges, for 1,000*l.*, all paddle-wheel steamers, for speed, sea-worthiness, stowage, and comfort, any vessel with the same, or double the power of the *Novelty*. Both vessels to have the same emerged and midship section."

To this challenge I have had no answer! This is as I expected; for, what steamer is there in the world, which, with a power of only 25 horses, and of 328 tons admeasurement, having 140 tons of ballast on board, and whose immersed section is 164 feet, would realize a speed of 8½ miles per hour?

This circumstance is altogether so unprecedented, that we must seek in vain to account for it upon any of the hypotheses by which the properties of screw propellers have been heretofore investigated.

I am myself a plain unlettered man, and have always felt what a more learned individual declared, after much hard *theoretical* study, namely, that "a *grain* of *practice* is worth a pound of theory." I therefore here give facts, which are *stubborn things;* and if I adventure upon a theory of my own, by way of accounting for the great result I have attained from such small means, I may be beaten and silenced on the argument, but I shall quietly point to the performance of the *Novelty*, as a proof that I am practically right. The theory to which I refer has been sneered at by those engineers to whom I have broached it, and I expect it will be so by others; but, as greater men have been laughed at by those who afterwards applauded them, I have no doubt that my theory will ultimately be admitted to be correct.

But first let me state the facts regard-

ing the *Novelty's* performance and power. The *Novelty* is a very burthensome vessel, built, as I have said, by myself, with a view of testing the application of steam in combination with a screw, as an auxiliary power to merchant ships. She is a three-masted vessel, with a capacious hold; and as her funnel forms the mizen-mast, and as she is, of course, without the clumsy appendage of paddle-boxes, she differs in no respect, in her external appearance, from that of an ordinary sailing vessel.

She is fitted with a pair of non-condensing engines; the cylinders are 13 inches diameter, and the length of the stroke 2 feet 4 inches; the effective force of the steam on the piston is about 20 lbs. mean pressure, being cut off at half-stroke. The engines make about fifty-five double strokes per minute, and the power is applied direct to the crank on the screw axis, without the intervention of gearing, or any kind of multiplying motion. The combined power of these engines will be found to be about twenty-five horses, and with these I have repeatedly realized a speed of eight and a half statute miles per hour! Now, I ask, what power would be required to propel such a vessel fitted with paddles at the same rate? I assert, without fear of contradiction, that you cannot do the same work with less than *three times the power*. If any one thinks I am wrong, let my challenge be accepted.

Now for my theory.

Let us suppose the screw and paddle-wheel each exerting the same propelling effort, and that the power of the engine is applied direct to the screw axis by means of a crank or cranks. It is clear, in such case, the pressure on the piston is not required to equal the propelling effort, because the latter is applied on the principle of the wedge; while in the case of the paddle-wheel, the pressure on the piston must be as many times greater than the resistance encountered in moving the floats, as the length of the crank is to the radius of the wheel.

The paddle-wheel also exerts its force in the direction of the vessel's motion, while the screw, acting as a wedge, requires a power equal to the perpendicular to give out an effort equal to the hypothenuse. Here then, the leverage is in *favour* of the *screw* and against the *paddle;* and this, I think, accounts for the great advantages I have attained.

If I am right in this theory (and I appeal to the facts for its confirmation,) then the methods employed by other experimentalists for increasing the velocity of the screw over that of the engine are all of them detrimental (independent of their complexity,) to the best application to the power, for they are multiplying the opposing lever, which multiplication I have shown to cause the inferior performance of paddle-wheel steamers.

The *Archimedes* is fitted with a pair of engines of the united power of ninety horses, and her screw has a multiplied velocity over that of the engine of 5⅓d times, and I find by Captain Chappell's report, as well as by Mr. Galloway's Appendix to Tredgold, that with an immersed section of only 135 feet, or 29 feet less than that of the *Novelty*, and nearly four times her power, she only attains a speed of ten miles per hour.

I am met on every side by the assertion, that when the power of the screw is obtained direct from the engines, the increased pitch of the screw will entail a greater loss by diagonal action. I will answer in the words of a learned mathematician, who had been attempting to investigate screw propellers, and who concluded his labours by declaring, that "results have shown us that we know nothing about angular action in the water." The fastest fish apply their force at the most acute angle to their line of motion, though the practice in screw experiments has been the reverse. In my opinion, the angle of power is the difference of the velocity of the screw and that of the vessel, and not the angle of departure.

If you will allow me space in your valuable columns, on a future occasion I will state more fully the grounds of my hypothesis. At present I shall wind up by enumerating the advantages of my plan, well assured that I am underrating their extent.

1st. Less than half the power is required.

2nd. No gearing or multiplying motions, the best of which are complicated and uncertain.

3rd. A saving of half the fuel with a proportionate decrease of labour in firing.

4th. An increase of room for cargo and passengers, to nearly double the space available at present.

5th. The steam power does not affect the sailing properties, and *vice versa*,

whereas, with paddle-wheels, the sailing power (from the cumbrous nature of the paddle-boxes and the immersion of the lee wheel, with the wind abeam,) is of little value.

6th. The weight of the propeller is not one-tenth of the paddle-wheels and their boxes.

7th. The beautiful appearance, and snug and safe rig of a sailing vessel is preserved by using the funnel as the mizen mast.

8th. A saving of nearly 20 per cent. in first cost, when equipped and ready for sea.

9th. A saving of at least 50 per cent. in disbursements.

10th. Room for carrying nearly double the amount of passengers and cargo, thus increasing the returns cent. per cent.

11th. The power of instantly disconnecting, shipping and unshipping, the propeller.

From all the preceding advantages it can require no argument to prove, that the time has come, when vessels, worthy the name of ships (and not boats, as the present race of steamers are properly denominated,) may be usefully and economically employed in carrying her Majesty's mails with safety and despatch; and that we may now use steam, when necessary only, that is to say, in adverse winds or calms, retaining therewith the capability of laying aside steam, and using the old-fashioned and cheaper power, "the winds of heaven" whenever they blow from the right quarters, instead of being compelled, in such cases, to consume our fuel and work our engines for no other purpose than that of preventing the inactive wheels from performing the office of a drag to the vessel's sailing velocity.

I am, Sir, your obedient servant,

H. Wimshurst.

2, Cowper's-court, Cornhill.

DR. MOSER'S DISCOVERIES IN PHOTOGRAPHY, AND NEW THEORY OF THE PHOTIC FLUIDS.

Sir,—The account published in your Journal, of Dr. Möser's photographic experiments, is highly interesting to me, as indicating the approach to the recognition of the existence of photic fluids. It includes, I think, what Mr. Hall has termed "Thermography," namely, the novel phenomenon noticed by Dr. Möser, "that any two bodies, when sufficiently near, impress their image one on the other, although both be in absolute darkness." Having devoted many years to the endeavour of tracing the connexion of *photic* matter with the elements, I beg leave, on this occasion, to submit to your readers the following general observations.

The only clue which I have been able to find to the chemical affinities of the inorganic elements, capable as they are of attracting, reflecting, and conducting heat, and of undergoing manifold atomic metamorphoses without destruction, is the hypothesis, that they must respectively consist of congerated *inert radicals*, *chemically saturated* with such proportions of imponderable, yet material *photic fluids*, as certain laws of nature allowed them to bind or appropriate to themselves, so as to constitute the existing diversity of apparently simple elements, while the very same fluids also abound in a *vivid* state. We cannot any longer doubt that the photic sunbeams are fraught with *radical* elementary matter,—similar to the chemical flame of terrestrial fire, but much sublimer and purer; and we may be justified in presuming that they deposit such radical matter on the terrestrial globe, saturated with photic fluids, capable of being *fixed* in a process of condensation, after contamination with terrestrial *effluvia*. We have next to consider that the terrestrial globe, with its gaseous atmosphere, is encompassed by a subtile *universal ether*, and may fairly assume that the latter pervades the whole ponderable and porous elementary mass. This omnipresent ether must be an inert imponderable fluid, itself saturated with the *still finer* photic fluids, diffused through it by the sun, and is thus their omnipresent conductor, preserving a vivid store, always ready to act upon the ponderable elements by affinity with their *fixed* photic constituents. Such I presume to be the constitution of our earth and all the planets, subject to the regulative and fostering influence of the sun.

The *photicated* ether in question, which I presume to pervade all nature, has not yet been recognized as being identical with the fine fluid contents of what we term *vacuum*. I consider that it is identical therewith; and if the atomic theory be reduced to the plain proposition, that all ponderable matter consists

of *vesicular*, more or less porous, perforated and *elastic* molecules, however minute and singly invisible, some being more expansible than others at a given temperature; it is reasonable to assume also, that, whether contracted or expanded, their central vacui, as well as the interstices between the atoms, must be replete with the said photicated ether, on the same principle on which air would replenish and encompass a heap of any hollow, perforated, and elastic globules. I have further come to the conclusion, that positive and negative electricity, positive and negative magnetism, are identical with *four* distinct photic fluids, discernible under certain circumstances, particularly in the body of a flame, by the *blue*, *red*, *yellow*, and the *colourless* or *water* hues, while the analysis of the sunbeams also exhibits negative (black) and positive (white) rays. We should thus obtain *six* distinct photic fluids, of which the last named two have no polarity in combination, but do alternately precede or lead, and may absorb the first named *galvanic four*. Let us also postulate, that in combination with the ether, *positive* electromagnetism constitutes *latent heat*, and *negative* electromagnetism—*latent cold*, and we may finally infer, that a concentration of the former around a combustible, or in the galvanic spark, is the radiating and conductible heat (diffused by gaseous fire or flame) by which organic bodies are dissolved—their ponderable atoms being separated, expanded or rarified, rendered volatile and caused to float about, until refrigerated and recontracted by contact with cold, so as to reconstitute themselves into inert elementary congeries. The heated ether is thus in the expanded atoms, what gas is in a balloon or air in a bladder. There is more *latent* heat in a vacuo, than in the air surrounding the receiver; and gases, when compressed, evolve heat—some also say, light.

The formation, growth and putrefaction of organic bodies is effected by slow atomic vibration or combustion at a low temperature; this process is incessantly going on in nature; it is the destiny of what we call matter. The laws of this process involve the important, yet unsolved question of elementary destructibility, which I do not wish to touch now, as it would lead me too far.

On the same principles, darkness would be owing to a vivid predominance in the ether, of negative—brightness or radiancy a predominance of positive, photic fluids. Whichever order of fluids is predominant, combats and repels the other, absorbing and neutralizing a certain residuum, so that neither is under any circumstances totally absent. The sun's radiance is a constant emanation and a re-attraction of chemical electromagnetic currents, retransmitted from the surfaces of the planets, in whose atmospheres they cause atomic vibration or undulation with brightness. In the sunbeams travelling along, their positive ingredients are foremost, the negative following in the wake; when hitting their object, they combine and intermix; the surface, the globe, absorbs less of the former than of the latter; thus a greater proportion is thrown back of the positive than of the negative, to cause atmospheric heat and undulation. By concentration of the sunbeams in burning glasses we have learnt to obtain solar fire; this was the first, and I deem it the greatest of the great discoveries that have been made down to photography, by which it is now proved, that all material bodies have constant *photic halos* of their own, radiating even invisibly and insensibly, "*in darkness as well as in brightness*," and capable of making impressions upon each other. This can only be owing to the affinity between the *fixed* photic ingredients of the elements and the vivid omnipresent *photicated ether*. And what does the polish of metals, the brilliancy of precious stones bespeak?

If you can kindly spare a page in your valuable journal for this letter, you will greatly oblige,

Sir, your most obedient servant,

Z.

London, December 31, 1842.

SAND TAMPING.

Sir,—In the November Part of the *Mechanics' Magazine* I perceive that a correspondent, J. F. B., is still of opinion that sand cannot be used for tamping. I beg to mention, for the information of others, that I have most successfully used sand for that purpose.

The experiments have been tried in a stone-quarry. A hole, 2 inches in diameter and 5 feet deep, was made in the rock. Half the charge was first put into the exploding cartridge, and next the

remaining half of the powder; then a tight oakum wad was put down, leaving a space of 5 or 6 inches between it and the powder: the hole was filled up with fine dry rabbit sand, to the depth of 15 inches.

The sand was not blown out, and the result was quite satisfactory.

The battery I make use of consists of 48 pairs of copper and zink semicircular plates, 8 inches in diameter: the plates are fitted to a suitable frame, with eight wooden discs, with rails mortised into them to support the plates. Through the centre of the wooden discs passes a strong wooden axle, which rests on the ends of the wooden trough, and only allows the plates to be within half an inch of the bottom of the trough. By turning a handle, the axle and plates are made to revolve, and can be immersed in the acid, or turned out of it, with the greatest facility.

I remain, Sir, your obedient servant,

H. M.

Wexford, December 28, 1842.

THEORY OF NUMBERS.

Sir,—In Barlow's "Theory of Numbers," a work I have lately begun to read, there is (Propos. 9) rather an elaborate demonstration of the proposition: That the product of any two numbers is the same, whichever of the two is the multiplier. Legendre, in his *Theorie des Nombres*, gives, I believe, a similar demonstration; and as the truth of it appears to me so evident, that it might be almost called an axiom, I have endeavoured to prove it in a shorter way, and shall be glad to know, through the medium of your valuable publication, whether the following demonstration is considered a satisfactory one.

If a and b are the two factors, call $ab = x$, $ba = y$, then $\frac{ab}{ba} = \frac{x}{y}$.

Now, $\frac{ab}{ba} = a \times b \times \frac{1}{b} \times \frac{1}{a} = a \times \frac{b}{b} \times \frac{1}{a} = a \times 1 \times \frac{1}{a} = a \times \frac{1}{a} = \frac{a}{a} = 1 = \frac{x}{y}$; whence, $x = y$ and $ab = ba$. Q. E. D. Which reasoning may evidently be extended to any number of factors.

I hope I am not intruding in addressing these lines to you; if I am not, I may perhaps take the liberty of addressing you again, from time to time, on similar subjects, offering more difficulties to the student who is beginning pure mathematics, and some of which he may be unable to surmount without the aid of a master. I cannot help being of opinion, that the important science, which is the only solid foundation of the subjects your Journal so ably treats of, would be greatly benefited by smoothing the way as much as possible, consistently with sound reasoning; though, at the same time, I am well aware that a "royal road" to knowledge does not exist.

I have the honour to remain, Sir,

Very respectfully,

A LOVER OF SCIENCE.

City, December 24, 1842.

EXPLOSION OF THE AMERICAN STEAMER "MEDORA."

Practical Conclusions in respect to Tubular Boilers.

[From Memoir in the Journal of the Franklin Institute, by Benjamin H. Latrobe, Esq., C.E.*]

Upon the 14th of April, 1842, the *Medora*, a new steam-boat, built by a company, to run between Baltimore and Norfolk, was prepared for a trial trip down the Patapsco. She lay at the engine-builder's (John Watchman) wharf, on the south side of the Basin. Her fire was lighted at about 2 o'clock, p. m., and about an hour after, the agent and some of the proprietors came on board, and she prepared to start. There were probably between 50 and 100 persons in her when she started, many of whom were workmen connected with her construction; and as on such occasions these persons, each deeming himself to be *magna pars* of the affair, are prone to intermeddle, there was much crowding and confusion about the en-

* The original of this very interesting memoir is illustrated by a number of very accurate engravings; but, as the parts here extracted by us are sufficiently intelligible without them, they are omitted. —Ed. M. M.

gine, and its proper management by the engineman was not unlikely to be interfered with. The pride of the workmen in the expected performance of the boat would naturally dispose them to do all they could to accelerate her speed; and the suspicion afterwards expressed, that undue means were employed to increase the pressure of the steam, was not unreasonable. It has also, indeed, been supported by sufficient testimony, though at the same time contradicted, I am told, by one of the surviving witnesses of the calamity.

The boat had just cast off her lines, and, in backing out, had made one or two revolutions of her wheels, when her boiler burst. Five-and-twenty persons on board were killed or mortally wounded; the upper, or promenade deck, over the boiler, was blown in fragments into the air, and the forward part of the hull so shattered, that she immediately sunk, in ten or twelve feet water. Her engine, except in its connexion with the boiler and the after part of the hull, was uninjured. The boiler was placed forward of the wheel-houses, standing fore and aft in the hold of the vessel, and rising up through the main, to within three or four feet of the upper deck. It was thrown upwards to the height of the top of the engine-beam, or more than thirty feet, and while in the air it turned, so as to fall upon its side, exactly crosswise of the boat. Circumstances connected with the escape of the steam and water, and the resistance of the wood-work of the upper deck, no doubt, caused this singular rotation.

The boiler consists of a cylinder eleven feet in diameter, and nineteen feet long, supported on three legs, of the same horizontal length, and composed of sheets of five and a quarter inches apart, connected, as usual, by staybolts. The side legs are about seven feet, and the middle leg two and a half feet high. To admit the water into these legs, the cylinder, or belly of the boiler, is cut away by rectangular apertures at frequent intervals. The lower half of the cylinder is occupied by forty-seven tubes, eight inches in diameter, through which the smoke and flame are returned forwards, from the chamber at the back of the boiler towards the chimney in front. Between and above the rows of tubes were round tie-rods, three-fourths of an inch diameter, horizontal and crosswise to the cylinder; but similar rods could not be introduced vertically between the tubes, on account of the spaces between them not coming in a line over each other. Thus, the top and bottom of the cylinder were not stayed by direct ties connecting them in the position of chords; but the top angles at either end of the boiler were braced by diagonal bars and rods, and above the tubes were one or two rows of longitudinal rods, of one inch diameter, going from the forward to the after head. The sheets of the boiler were of the *usual* thickness of one-quarter of an inch, and do not appear to have been of bad quality. There were two fire-doors in front, for the introduction of the fuel into the spaces between the legs; and in the sheet-iron composing the front of the smoke-chamber supporting the chimney stack, there was a small, movable, circular door opposite each tube, for the insertion of an instrument to clean the flues when required. The number of gauge-cocks was *four*, the lowest being a little above the level of the highest row of tubes. The safety-valve was placed upon a drum near the top of the boiler, and was, as will be seen hereafter, of large dimensions.

Such was the boiler in all its parts; and its unusual size and bold design must be striking to every observer.

An examination of the wreck of the boiler, as it still stands in the yard of Mr. Charles Reeder, engine-builder, clearly shows that it first gave way where the legs unite with the belly, and where the removal of so much of the metal reduced the strength of the cylinder to its minimum. The explosion was *downwards*, carrying away the right-hand, or starboard leg, and the middle one, and tearing into shreds the inner sheet of the larboard leg, at its junction with the cylinder. The escape of the steam and water, principally on the starboard side, probably caused that side to revolve vertically in the rise of the boiler into the air, and thus would have made it fall upon its larboard side in the descent, while at the same time a horizontal revolution was effected by the forward rush of the expelled fluid towards the angle made by the front and starboard side, this part of the front appearing to be pushed outwards. The boiler evidently fell first upon the hind and upper larboard corner, which is seen to be much crushed, while the explosion operated most powerfully on the front and lower starboard corner. These two corners are diagonally opposite to each other, and this circumstance may account, (in connexion with the entanglement of the boiler in the fragments of the upper deck,) for the rotation. As the boiler lay in the hold on its larboard side after the explosion, the starboard and middle legs, together with the portions of the cylinder between them, were not entirely detached, but were so far bent backwards, and curled over, as to embrace the circular top; and, previous to the raising of the boiler out of the sunken hull of the vessel, they had to be separated by the chisel. The cutting of the apertures

over the legs, in the manufacture of the boiler, to admit the water into them, left the segments of the cylinder, between the legs, united only by the strips of sheet metal remaining, and of these strips not more than one-half the original number are left, the rest being carried away by the explosion. The other injuries received were partly due to the rupture, and partly to the fall of the boiler; and the numerous and extensive rents manifest the insufficiency of the opening first made, though large, to vent the confined fluid, and that the destruction, once begun, proceeds ad libitum, as in almost all similar cases.

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The construction of the boiler, and the manner of its destruction, having been thus described, I proceed to estimate its strength from the data I have procured, together, and in comparison, with the probable pressure of the steam at or near the time of the explosion; and to state the facts of which I received information, respecting some of the circumstances of the accident, accompanied by such remarks as have suggested themselves to me, in regard to its causes and effects.

The weakest part of the boiler, to which the calculation must evidently be applied, was manifestly the part of the cylinder immediately over the legs, where the continuity of the sheets was interrupted by the apertures made in them to let the water down into the legs, and promote its circulation throughout the vessel. One-half of the strips of iron left between these apertures has been carried away, and the measured width of those that remained is irregular; but there is enough to show that the united breadth of all the strips did not exceed that of the spaces between them, so that the boiler was not more than half as strong over the legs as elsewhere, *ceteris paribus*. Thus, in every twelve inches of the length of the cylinder there were but six inches of sheet-iron to unite the segments separated by the legs. A further reduction of strength, in the connexion of these segments, was again made by the occurrence of seams in the strips, depending on rivets, and weakened by the holes punched for their insertion. Now, the strength of a joint of this kind will depend upon the resistance of the rivets, and also on that of the remaining iron of the plates which they unite; which resistances should manifestly balance each other, to give the maximum of strength to the joint. The plates may be separated in three ways: 1. By cutting off, or tearing asunder the rivets, or tearing off their heads; 2. By splitting and tearing out the metal between the rivet holes and the edge of the sheet; 3. By tearing off the sheet-iron between the holes, and in a line with their centres. That it may be indifferent, so far as dimensions are concerned, in which of these three ways the joint may separate, there must be certain fixed proportions between the diameter of the rivet, (the head of which we will suppose to have always such an excess of strength, as to make the shank of it give way first,) the clear distance between the rivet holes and the edge of the plate, and the clear distance between the holes themselves, the thickness of the sheet being, of course, a constant element. Let us now see whether, in the riveting of the sheets of this boiler, the correct proportions were observed. 1. The rivets are eleven-sixteenths of an inch in diameter, and each has a transverse sectional area of 0·375 of a square inch, and, there being three rivets to every *strip* of six inches wide, the whole area of the rivets will be 1·125 square inches; 2. The line of metal left between the holes will be $(6-2{\cdot}062)=$ 3·938 inches wide, which multiplied by one-fourth of an inch, (the thickness of the sheet,) will give an area of 0·985 of a square inch; 3. The clear distance of the holes from the edge of the sheet is one and a quarter inch, which, multiplied by one-fourth of an inch, gives an area of 0·312 of a square inch, and for the three holes, a total area of 0·936 of a square inch. The three resistances appear thus to be somewhat unequal, that of the rivets being the greatest, by 14 per cent., of the strength of the metal between the holes, and 20 per cent. of that of the metal between the holes and the edge of the sheet. But when it is recollected that in the first case the rivet loses part of its whole strength by the strain it suffers in cooling, after being headed in a heated state, and that in the third case the tearing out of the metal involves more than the mere separation of the area of resistance, inasmuch as to permit this, the metal must be considerably bent on either side of the line of rupture through which the rivet makes its way out, and as furthermore, the *friction* of the lapping surfaces of the plates augments their opposition to a separation by sliding on each other, it would seem as if the three resistances were very near to a practical equality, and that the sizes, numbers, and positions of the rivet holes were about what they should be, for the required equilibrium between the parts of the joint. Other boilers which I have examined show a similar adjustment of parts in the joints, so that the general practice would seem to accord with the conclusions of the present calculations. An inspection of the manner in which the plates of the *Medora's* boiler separated at the seams, showed that, in most instances, the

metal between the rivet holes and the edge of the sheets, gave way by tearing out, leaving the rivets and intermediate metal uninjured, and this consists with the preceding estimate which makes this element of the joint the weakest of the three. Inasmuch, however, as they approach so nearly an equality of strength, and each may occasionally give way before the others, it may be as well to take the *average* of their resistances for an expression of the strength of the joint, and this should be $\frac{1\cdot125 \times 0\cdot925 + 0\cdot936}{3} =$ 1·015, or say one square inch of metal for every 12 inches (6 inches of strip and 6 in. of space) in the length of the boiler, $\frac{1}{12}$th of a square inch, per running inch of the same; and this is the measure of the strength of that part of it over the legs. Now the elements of the calculation to determine the strain that a cylindrical vessel will bear, from the outward pressure of an elastic fluid, consists of the diameter of the cylinder, the thickness of the material composing it, and the modulus of the strength of that material. Thus, if D be the diameter of the cylinder, t the thickness of the iron (both in inches,) P the average force in pounds that will tear asunder a square inch of boiler, iron, and x the steam pressure per square inch on the boiler sufficient to burst it, we have the equation $D x = 2 P t$, where $x = \frac{2 P t}{D}$.

Now $D = 132$ inches — $P = 55{,}000$ lbs. $t = \frac{1}{4}$ of an inch. Consequently $x = 208\frac{1}{3}$ lbs., which would be the pressure of the steam per square inch required to burst the boiler, if it were a continuous hollow cylinder without seams or joints to reduce the quantity and resistance of the metal composing it. But this is not the case in any boiler. The joinings of the plates, if there were no holes in the boiler, would necessarily reduce the strength to about two-thirds of the entire strength of the sheets, were it not for the support they yield each other at the *laps*, where they are doubled upon each other. In the *Medora's* boiler, it is seen above, that for every 12 inches in the length of the cylinder over each leg, there is but one square inch of metal resisting rupture, instead of three square inches, which there would be if there were no rivet holes, or spaces, between the strips of iron. So the strength of the boiler over the legs is reduced to the one-third of it full strength in other places, where there are so seams, or perforations; consequently, we must divide the value of x, as above obtained, by 3, to get the real pressure, per square inch, that the boiler was capable of sustaining. Then $\frac{208 - 33}{3} = 69\cdot44$ pounds per square inch, the utmost strain that this boiler could have borne, without giving way at this, the weakess place. The pressure here spoken of, is of course the *effective* pressure, or the excess of that of the steam over that of the atmosphere.

Let us now proceed to estimate the pressure which could have been produced upon the boiler of the *Medora* by loading the safety valve to the utmost with the weights which were *attached* to it, and intended so to be used, when occasion should require the maximum pressure, considered by the engine builder to be safe. The diameter of the valve was $15\frac{1}{4}$ inches at the bottom, with a mitre of $1\frac{3}{4}$ inches, making its top diameter 17 inches. The levers of the valve were of the second order, and two in number. The primary lever, operating immediately on the valve, had a total length of 35 inches, and from the fulcrum to the centre of the valve disk, was $12\frac{1}{2}$ inches, making a ratio of $\frac{1}{2\cdot8}$. The secondary lever, operating on the end of the primary one, had a total length of 67 inches, and from the rod connecting the two, to the fulcrum of the former, the distance was 10 inches. There were two weights of cast iron, on the secondary lever, the largest, nearest to the end of it, weighing (by estimate) 200 pounds, and the smaller 56 pounds. When these two weights, which slid as usual on the arm of the lever, which they were perforated to receive, were in contact, and pushed out to the end of the lever, the distance of their centre of gravity from the fulcrum of the long lever, would be $57\frac{6}{10}$ inches; so that the ratio of this lever would be $\frac{1}{5\cdot76}$ and the ratio compounded of those of the two levers $\frac{1}{5\cdot76} \times \frac{1}{2\cdot8} = \frac{1}{16\cdot128}$.

If the area of the valve be calculated, from its mean diameter, viz: $\frac{15\cdot25 + 17}{2} = 16\frac{1}{8}$, it will be found $= 204\frac{2}{10}$ square inches. Then the extreme pressure which the attached weights could produce upon the safety valve would be equivalent to 256 lbs. $\times\ 16\cdot128 = 4128\frac{77}{100}$ lb. or, per square inch of the valve $= 20\frac{22}{100}$. This is exclusive of what is due to the weight of the valve, and its rod and lever, which may be estimated as follows: for the valve itself, without leverage, 100 lbs.; for the short or primary lever, 20 lbs. $\times \frac{17\cdot5}{12\cdot5}$ (the leverage of its centre of gravity) = 28 lbs.; for the connecting rod, 10 lbs. $\times \frac{35}{12\cdot5} =$ 28 lbs.; for the long or secondary lever, $56\frac{1}{4}$lbs. $\times \frac{35}{12\cdot5} \times \frac{33\cdot5}{10} = 536$ lbs., being in all 692 lbs. *at the seat of the valve;* and

this will increase the whole pressure there to $4820\frac{77}{100}$ lbs., or to $23\frac{6}{10}$ lbs. per square inch of the valve and boiler.

This appears to be the highest pressure which could be brought upon the boiler, by the system of weights and levers, belonging properly to the valve.

The strength of the boiler, in its weakest places, being then estimated, as above, at $69\frac{44}{100}$ lbs. per square inch, amounted to just three times the extreme pressure which the engine builder appears to have intended it should be called on to bear, and in proportioning the strength of his work to the duty it was to perform, he would seem to have been sufficiently prudent. How, then, did the boiler explode, when guarded by a safety valve of such ample dimensions, designed to give way at one third of the bursting strain?

That the free action of the valve must have been interfered with, would be a natural conclusion, and is corroborated by the testimony of one of the assistant enginemen.

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But the boiler may have been in fact weaker than it has been estimated, from a deficiency of strength in the iron of which it was made, and which has been assumed at 55,000 lbs. per square inch. The numerous experiments that have been made upon the strength of this metal (of which those recorded in the *Journal of the Franklin Institute*, vols. xix. and xx., 2nd series, are the most extensive and satisfactory that I have seen, and also the most applicable to the present case, as they were made upon boiler iron,) show that its cohesive power as often exceeds as it falls short of that measure, which may be taken as a fair average. If the iron of the *Medora's* boiler was, in fact, of bad quality, it may, however, have possessed a tenacity far within that just given; but it scarcely could have descended as low as the one-third of 55,000 lbs., or to 18,000 or 19,000 lbs. per square inch, which it must have done to have yielded to the steam pressure of $23\frac{6}{10}$ lbs. per square inch, supposing the preceding estimates of strength and pressure to be correct. My examination of the iron, as it appeared on the torn edges of the sheets, did not impress me with an unfavourable opinion of its quality, although it showed the distinctly laminous structure which most sheet iron exhibits. Its strength in the ruptured parts could not have been diminished by over heating, for those parts were far under the lowest level to which it is in the least degree probable that the water could have fallen, even had it declined below a safe and proper height. Moreover, the *strips*—the giving way of which caused the bursting of the boiler—were so situated that the fire could not have been at all in contact with them had the boiler been *dry*, as they occupied the spaces over the legs, and, consequently, must have been always immersed either in water or steam. There is, however, no evidence that the water was deficient in quantity at the moment of explosion; on the contrary, many witnesses declared that the gauge cocks showed a full supply, and, considering the vast size of the boiler, the shortness of the time between the lighting of the fire and the occurrence of the explosion, it seems not likely that the evaporation could have sunk the water to a dangerously low level, if, as is to be supposed, it was properly filled at first. I could, indeed, discover no trace of injury to any part of the boiler by burning of the metal, and my examination of the uppermost tubes, and the top of the back smoke chamber, was very careful, and if these parts of the boiler *were* overheated, they, nevertheless, stood firm, and left the rupture to take place elsewhere. No incrustations likely to impede the transmission of the caloric to the water, and thus render the iron liable to burn, anywhere appeared, and were not to be expected in a perfectly new boiler. The degree of heat imparted to the parts of the boiler covered with water, would not, at all events, have exceeded the temperature due to the effective pressure of about $4\frac{2}{3}$ atmospheres, or $69\frac{44}{100}$ lbs. per square inch, which has been above estimated as sufficient to burst the vessel. This temperature (see *Journal of the Franklin Institute*, vol. xvii., page 291, 2nd series,) is not more than 300 degrees of Fahrenheit, and the experiments recorded in the same journal (vol. xx., pages 24 to 31, 2nd series, and curve traced in plate X.,) show that the tenacity of iron is *increased* by heat, until a temperature of at least 400° Fahrenheit is surpassed, when it begins to diminish. The boiler, then, could not, in my opinion, have burst from overheating the metal *in the parts where the rupture actually took place*—to wit, in the strips over the legs, uniting the segments of the cylinder between them. In estimating the strength of these strips, I have supposed, from inspection and measurement of those that remain, that they contained one-half of the original quantity of metal in the sheets, which was further reduced to one-third of that quantity by the rivet holes. In this estimate there is room for mistake, and, possibly, I may have in this assigned more strength to the boiler than it in fact possessed. In both the quality of the iron and the amount of metal in the strips, then, there may be room for considerable reductions upon the preceding calculations of the ability of the boiler to withstand the pres-

sure of the steam. Again, although the metal did not, on account of its greater strength than that of the strips, give way where, if at all, it must have overheated—viz. in the top of the smoke box, or in the upper flues—there is a possibility that these parts may have been laid dry by the falling of the water, and have become so hot as to generate suddenly a larger body of vapour (or, who knows, an explosive gas,) than the safety valve could vent with sufficient rapidity to save a rupture, even if that had been loaded to less than the strength of the boiler. This supposition is, however, in the face of the *evidence*, though, unfortunately, too little credit is due to such testimony in cases of this kind.

It is stated, by several witnesses, that the safety-valve did not *blow* at all while the steam was getting up, and that from the time of making the fire, up to the moment of the explosion, not more than two or three short *puffs* proceeded from it. These would, indeed, suffice to show that it could not have stuck fast in its seat from the action of some adhesive force—an instance of which kind is on record. But it also proves that if, after all, the valve was not overloaded, at least the engineman and his assistants, &c., were strangely indifferent to the unusual absence of that audible evidence of its free action, which always attends the starting of a steamboat.

Although doubt must continue to rest upon the true and special cause of the explosion of the boiler of the *Medora*, and I am not prepared, in relation to that cause, to offer more than the preceding facts and inferences, for the judgment of others, yet some general conclusions may, I submit, be satisfactorily derived from the circumstances of this catastrophe. First—the boiler was too large in its diameter for the strength of metal employed, looking to the risk of bad material and workmanship. The thickness of the sheets was a quarter of an inch—a thickness, by the way, almost universally employed in the construction of steam-boilers of all diameters, as if there were some magic in this particular dimension, which made it most pliantly applicable to all cases, however varying. Referring to the formula $x = \frac{2\,P\,t}{D}$ we find that iron one quarter of an inch thick would require a pressure of 573 lbs. per square inch to rupture it in a cylinder of three feet diameter, (a diameter of usual occurrence in locomotive and other high-pressure boilers,) if the modulus of its strength be 55,000 lbs. per square inch, and a deduction be made *for the seams*, of twenty-five per cent. While the *Medora's* boiler, of eleven feet diameter, and the same thickness and strength of sheet iron, would have borne but 156¼ lbs. per square inch, with a proportional reduction of one-quarter for the joints, (saying nothing of the still greater subtraction of strength due to the apertures over the legs,) can there be any propriety in using the same thickness of plate for each of these widely differing diameters? Yet it is done under the influence of the apparently *prescriptive right* of the quarter inch iron to be employed in all cases whatever. It is true that the small diameter boilers are high-pressure, and subjected to the greater strain, but their excess of strength is, at the same time, vastly greater than that of the large low-pressure boilers. The usual high-pressure strain is, perhaps, about 100 lbs., and the low-pressure strain, 25 lbs. per square inch. The excess of strength in the three feet high-pressure boiler is, then, 473 lbs. per square inch, and in the eleven feet low-pressure boiler of the *Medora* it would be but 126¼ lbs. per square inch. It may be said, indeed, that the ultimate strength of the former is but 5·73 times its usual strain, while that of the latter is 6·25 times its ordinary stress; also, that at the high temperatures accompanying high pressures, a given increase in the temperature causes a more rapid rise in the pressure than at the low temperatures of the lower pressures, so that there is occasion for more excess of strength in the former than in the latter cases, to guard against accidental augmentations of temperature. Also, that the consequences of explosion at high pressures are more disastrous than at those of a lower grade, and should, therefore, be more carefully guarded against. There may be some propriety in the two first of these suggestions, but not so much in the last, as some of the most fatal explosions have occurred in low-pressure boilers; and still I think that low-pressure boilers, whose diameters are generally from eight to nine feet, are usually too weak when made of quarter inch iron; and this opinion is held *à fortiori* in regard to the *Medora*, with her boiler of eleven feet across. Braces are indeed used in these large boilers, but with often only partial effect, and in the *Medora*, as has been already remarked, they could not be applied in the vertical, or radial direction, in which they would have done most good, on account of the positions of the tubes.

Second—a boiler of the colossal size of that of the *Medora*, presents a bold and striking aspect, and seems fitted for the generation of a vast supply of steam; and so, doubtless, was the boiler in question, the fire surface and steam room of which

was of unusually ample extent. But the same fire surface will be as effectual if distributed among two or three boilers, and with great increase of security against explosion. The one large boiler will, perhaps, cost less in the manufacture, and occupy less room in the boat, but it will be much more difficult to move, in placing and displacing it; and if accident happens to it, the supply of steam is wholly cut off; while with more than a single boiler, each of which can be insulated from the other, it may be kept up, and the engine worked at a lower speed, till the injured boiler is repaired.

Third, the design of a boiler resembling the *Medora's*, is deficient in strength at the junction of the belly with the legs which support it, and form the sides of the fire-place. The perforations of the cylinder *must* be large enough to permit the water and steam bubbles to pass freely up and down, in the necessary circulation of them through the boiler. *Small* holes over the legs would not allow this; the circulation would be checked, less steam would be generated, and the legs of the boiler become unduly heated for want of the constantly required supply of cold water, which, in a boiler with no obstruction to circulation, is constantly descending towards the fire, from the upper and cooler parts of the vessel—towards which last, the steam bubbles are simultaneously rising to the steam chamber; the two currents thus running contrary to each, without mutual interference, as their very different specific gravities maintain an easy separation between them. Thus the *vertical* has an advantage, in regard to circulation, over the *horizontal* tubular boiler; the tubes of the former interfering much less with the passage of the two counter currents, and its fire-place being at the *bottom* of the boiler, instead of at one end of it, horizontally, gravitation gives more assistance to circulation. The maker of the *Medora's* boiler was right, therefore, in giving wide passages for water into the legs, but, as to do this necessarily weakened his boiler so much, it shows a faultiness in its plan. It is not, indeed, easy to see why he departed from the usual mode of building boilers of this character by arching the fire-places, and so arranging his flues as to permit numerous ties in a radial direction across the boiler, connecting the outer shell with the fire-arches, as well as the flues. Here no cutting of holes would have been required, and any degree of strength given without interference with circulation. The ties introduced into the *Medora's* boiler, are not in the most effective position. A tie, or brace, in a cylindrical boiler, should never, if possible, occupy any other position than that of a perpendicular to the surface supported by the tie or brace. Here they are *diagonal* to the ends and roof, and as chords, *less than diameters*, across the cylinder.

Some other obvious remarks suggest themselves, in conclusion, and are generally applicable to steamboats when under trial, on such occasions as this ill-fated vessel was about to begin.

Most of the persons on board the *Medora*, at the time of her explosion, were, as before stated, workmen who had been engaged in her construction. It was not safe to leave the boat as it *was* left, in the hands of these men, most of them, probably, reckless of danger by character, and fired with the false ambition congenial to the occasion. The safety valve and mercurial gauge should have been constantly under the eye of the engine builder, whose machine was being submitted to proof. The valve lever and its attached weights, and the means of moving them, should have been so constructed, and surrounded by guards, as to make it impossible that more than the extreme pressure designed to be put upon the valve, could be applied without doing violence to the defences of the apparatus. The boiler (as should all steamboat boilers) should have been provided with a small pumping steam engine, to keep up the water, as at such times, especially, the boat has often to wait a good while before starting, the water gets low, and the engine man and his *assistants* (viz., the crowd around him) are too excited, and anxious for a quick and favourable commencement of the trip, to go to work at the drudgery of pumping up by hand. Frequent trials of the state of the safety valve should be made, and it should not be left to *blow of its own accord*, at a safe pressure, but should be raised by force, and the surplus steam permitted to escape. This would prevent the valve from *adhering to the seat*, as it has been known to do, in consequence of the rusting of the iron, or the introduction of some glutinous or cohesive matter thereto. The propriety of these and similar precautions, need not be enlarged upon. It is remarkable, and yet a clear consequence of the laws of mechanical *momentum*, that, in all these explosions, the rents made in the vessel should be so much greater than necessary to vent the steam and water with the rapidity that one would suppose far more than sufficient to relieve the pressure upon all other parts of the boiler than the part *first ruptured*, so much as to save them from injury. While the confined fluid is quiescent, however powerful its effort to escape, it does no harm, except in the preparation it is making to

force an outlet, by gradually increasing its strain on the metal, until an equilibrium is attained between the two forces of impact and resistance. But the instant that equilibrium is passed, upon a single square inch of the vessel, and the imprisoned fluid begins to put itself in motion, it breaks its way out, in a hundred directions instead of one, and we see parts of the vessel, of extremely unequal strength, giving way at the same moment. Thus in the *Medora's* boiler, several pieces were blown out at the back, which were unquestionably far stronger than the strips of metal over the legs. The sudden escape of the steam and water, also, acting on the sides and bottom of the boat, give to the boiler that projectile force which throws it, *en masse*, into the air, and inflicts other great injuries in its fall. In all considerable explosions, indeed, the boiler has been more or less *displaced*.

Thus is demonstrated the unsoundness of the opinion that *simple pressure*, steadily increasing, within a steam boiler, ought to open the *seams*, as being the weakest part of the vessel, and thus provide a safety valve, for the escape of the vapour. To account for the fact that boilers *never do give way in this manner*, the hypothesis of explosive gases has been paraded, with, as I humbly conceive, very little foundation in fact, although rare instances of that description may have occurred under particular circumstances.

ABSTRACTS OF RECENT AMERICAN PUBLICATIONS.

[Selected and abridged from the *Franklin Journal* for October and November 1842.]

IMPROVEMENTS IN THE PROCESS OF HARDENING STEEL.—*Perry Davis*.—The method of hardening steel as practised by the patentee is as follows:—" Instead of plunging the steel to be hardened into cold water, as is usual, it is plunged into a composition of borax, oil, and charcoal, to harden it, which mode of hardening renders the metal malleable with the same degree of hardness that was obtained by the old method; so that the metal, after being hardened in this way, can be straightened or bent without any danger of being broken."

Claim.—" What I claim as my invention, and which I desire to secure by letters patent, is the mode of hardening steel so as to render it flexible by means of the composition of oil, charcoal, and borax, as set forth."

What influence the above described mixture can exert upon the part to be hardened, we are at a loss to perceive, and apprehend that the method frequently practised of using oil alone, would have the same effect with the compound above indicated. We have been in the habit of hardening steel, and know of many devices which have been resorted to for the purpose of communicating toughness, but believe them all to be founded in error. The less rapid the cooling, the less will be the hardness, and, of course, the greater the toughness of the article operated upon.

IMPROVEMENT IN PROPELLING BOATS. *Meredith Mallary*.—There is to be a common water-wheel, such as is used for driving mills, on each side of the vessel, or boat, immediately in the rear of the ordinary paddle wheel, and the shafts of the two sets of wheels are to be geared together; the water which is thrown up by the common paddle-wheels is to fall into the buckets of the water-wheels, and is there to lend its aid in the business of propelling.

Claim.—" Now what I claim as my invention is the applying the water lifted or thrown up by the paddle-wheels of steamboats, so as to produce an auxiliary propelling power, in the manner described, or in any way analogous thereto."

That these auxiliary wheels will exert some influence we have no doubt, but we are much mistaken if they do not prove to belong to the class of consumers only, and that of the worst kind, as they will not pay for what they devour.

IMPROVEMENTS IN THE CONDENSER AND APPARATUS FOR SUPPLYING STEAM-BOILERS. *Joseph Echols*.—The apparatus, as described, for supplying boilers, consists of a receptacle, communicating with a cistern and with the boiler, by means of pipes governed by a four-way cock, which alternately forms a connexion with the cistern, from which to receive the water, and then with the boiler to supply it with the water thus received. The pipes forming these connexions are narrow and high, and the one leading to the boiler has an inclination towards and opens into it above the water line. Thus, when the communication between the boiler and receptacle is open, the steam from the former passes into the latter, and from this the water runs down the lower inclined surface of the tube into the former. The cock being then turned, cuts off this communication and opens it with the reservoir, which allows the water to run into the receptacle and condense the steam by which the water was expelled in the previous part of the operation. For low pressure engines, it is said that the top of the reservoir must be closed, and a connexion formed between it and the condenser.

The condenser is divided into two compartments, separated by a diaphragm pierced

with small holes, and this forms a connexion with a cistern of cold water by means of a four-way cock and receptacle, such as are employed in the apparatus for supplying water, and operates in the same manner. The condenser is also connected with the cylinder of the engine, and is provided with an aperture and valve for the discharge of air and water. The water, after passing from the cistern into the receptacle, escapes into the upper division of the condenser, and percolating through the perforations in the diaphragm, condenses the steam. The air is forced from the condenser into the receptacle by the entering water, and in the same manner from the receptacle into the cistern.

Improvement in the Wind-Mill. *Perry Davis.*—This patent is taken for a modification of the ordinary vertical wind-mill, with inclined sails, or vanes. The shaft of the wind wheel has its bearings in the upper part of a tower, which rests, and turns, on a circular railway, and on a hollow shaft attached to the main framing. A solid shaft passes through the hollow shaft of the tower, and is made to revolve by a crown wheel on the shaft of the wind wheel; and from its lower end, motion is communicated to any kind of machinery to be driven. The lower inner edge of the tower is provided with cogs into which the teeth of a pinion, on the end of a vertical shaft, take for the purpose of turning it. This last mentioned shaft is connected with a centrifugal regulator, or governor, the balls of which are operated on by a sliding clutch that clutches either of two bevel pinions on its shaft, so that when the mill runs too fast the balls are thrown out so far as to clutch the upper wheel, and thus to turn the tower, and the wind wheel, from the wind; and when it runs too slowly, the balls fall, and clutch the lower wheel which turns the wind wheel to the wind.

Hydrostatic Press for Pressing Cotton, &c. *John Houpt.*—The follower of this press is below the bed, hence, in the operation of pressing, it is forced upwards; and, to insure its parallelism with the bed during its action, there is a connecting-rod, jointed at each end of it, which rods extend upwards, and are jointed to the ends of two levers, which two levers have their fulcra in the cap of the press, their inner ends being connected together by a jointed link.

The second improvement is in the employing of an air-vessel with a large force-pump, to be used in the commencement of the operation of pressing, and before great force is required; the latter part of the pressing is to be effected with a small pump without the air-vessel.

Claim.—"What I claim is, first, the manner of combining the follower of the press with its head, or cap-piece, by means of two lever beams, and their connecting-rods, arranged and operating in the manner, and for the purpose, set forth; and, secondly, I claim the combining with the force-pump of the hydrostatic press an air-chamber, the air in which shall be compressed in proportion to the force with which the press is operating, and in such manner as that it shall, by its reaction, gradually diminish the quantity of water raised from the reservoir, and thus graduate the action preparatory to the operation of a smaller or more powerful force-pump, as herein made known."

Improvement on the Steelyard. *Eli Willemm.*—The fulcrum pins, or knife edges, that receive the loops of the hooks, in the improved instrument, are attached to rings that turn on the steelyard, or lever, instead of being attached to the steelyard itself. These rings are retained in their places lengthwise by means of flanches, or other known means. Instead of being made flat, and having only one or two edges notched and graduated to receive weights, as in the common steelyard, this instrument is to be made square, and is graduated and notched on three sides to receive the weights, by which the capacity of the apparatus is increased: either of the notched angles may be turned uppermost.

Improvement in the Spring Seats of Riding Saddles. *Thomas Mardock.*—The claim in this patent is confined to the peculiar mode of affixing and forming the spiral spring, called by the patentee the "jew's-harp spiral spring," and which is made out of a single piece of wire; but the formation of it could not well be understood without drawings, and these we deem it unnecessary to give. In this, as in other spring saddles, one end of the spring is attached to the pommel, and the other to the web which is secured to the cantle of the saddle-tree. The spring is easily constructed, at little cost, and will, no doubt, operate well.

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COMMANDER BEADON'S LIFE BUOY.

COMMANDER BEADON'S LIFE BUOY.

Sir,—Two great difficulties in the present excellent *Life Buoy*, invented by Lieutenant Cooke, and now used in the Navy, have for a long time occupied my attention: these are, the want of method to prevent the rapidity of its drift, and means whereby a man may regain the ship, after he has been able to get on the Life Buoy. Of the first of these, numerous proofs are afforded by the fact that good swimmers have often struggled to the last stage of exhaustion before they could reach the buoy—although they have been close to it at first, simply because it has continually drifted from them, almost as fast as they swam. In proof of the second, instances have often occurred of an unfortunate shipmate having of necessity been abandoned to a protracted and miserable death, when the weather has been too rough to lower a boat. Other instances are given where attempts made to assist men on the life buoys now used in the navy, have proved most disastrous. It will be sufficient for the present to refer to the loss of a whole boat's crew belonging to her Majesty's ship *Melville*, bearing the flag of Sir John Gore, off the Cape of Good Hope, in 1832 or 1833.

When a person falls overboard, the Life Buoy is "let go," and the ship kept close to it; but in a gale of wind, with the sea running high, this cannot be done, for the ship, owing to her lofty spars, will drift faster than the buoy; consequently, the distance between them continually increases, until both buoy and man are lost sight of to windward. I can refer to several eye-witnesses of such indescribably agonizing and heart-rending farewells.

The first named of these objections is in a great measure obviated by the deep keel of my Life Buoy, the position of the light staff before the centre of motion, and the effects of the wind acting against it, whereby it is caused to drift nearly "broadside on."

The second is overcome by means of the double-bladed oar, by which a man can propel himself faster than a vessel drifts in a gale of wind.

I moreover think, my buoy would be a desirable appendage to every ship, as it is calculated for running out a line in the event of her becoming stranded. It will also be a ready and safe means for one person to proceed to the rescue of others from drowning; for the conveyance of a message after or during an action; in short, it is a portable life apparatus calculated for use when boats cannot encounter the sea, or are not immediately at hand, or have been rendered unfit for use by shot or other causes, which the apparatus in question is not likely to be, from its diminutive size, construction in compartments, and places of suspension under the "taffrail." The present invention did not originate in a mere chance thought, but was commenced with a wish to attain the above desirable ends, and matured by a course of laborious and expensive practical experiments.

I have tried many plans for propelling it, more especially the principle of the "Screw," as far back as 1833, and the "Duck's Foot," at a later period, besides many others; but for simplicity and effectiveness the "Oar" surpasses all for the present purpose.

I offer the invention untrammelled by restrictive rights. Its expense is trifling; and I therefore trust that humanity may supersede prejudice, and that its utility may be further tested.

George Beadon, Com. R.N.

Bristol, December 6, 1842.

P.S. I cannot help thinking that my buoy would have been beneficial in many of the cases of shipwreck recently detailed in the papers. I will name one only—that of the *Waterloo*, where, I think, a line might have been taken on shore, for instance, the deep sea lead line, by which others could have been sent.

Description of the Engraving.

The prefixed engraving represents a man seated upon a moveable Life Buoy, in the act of returning to a ship to leeward. It consists of a metal tube 8 feet long by 12 inches at its greatest diameter, and is tapered towards its after end so as to permit it to pass freely through the water. It is conical at each end, in which are "eyebolts," for the double purpose of attaching a rope to tow it by, and to steady it when suspended at the stern by passing over guide rods fixed therein. The keel (a portion of which is seen) is 10 or 12 inches deep.* The

* This method I conceive to be advisable in the construction of all buoys, and water-marks.

buoy is quite safe from filling with water, it being divided into compartments or cases: these cases or drums are water-tight, and distinct from each other as well as from the outer cylinder, but are made to fit it nicely, whereby it is much strengthened and supported on the inside against any external blow or pressure. A saddle is formed in it, in which the man sits quite secure from sharks, or from being washed off, his feet resting on a pinion. On each side is attached a frame-work or wing with stop hinges, secured by bolts passing into circular pieces of wood, fitting the cylinder. On the underside of these wings are fixed semicylindrical buoys, which terminate in semiconical extremities. These wings hang down when the buoy is suspended across the taffrail, but form outriggers when in the water, thus giving it stability. The light-staff is moveable on an axle, and so arranged that it lies parallel with the buoy when hung up to the ship, and assumes an upright position when in the water; by this contrivance, there is not more available space occupied than by the buoy now used. It is fired, and let go in the usual way, and is propelled by a double-bladed oar, 8 feet long, which is attached to a moveable shole pin, suffering it to have a horizontal and vertical motion, but securing it from loss. It may also be propelled by two paddles fixed in a similar way at their ends.

MR. DREDGE'S SUSPENSION-BRIDGE SYSTEM—PROFESSOR MOSELEY IN REPLY TO MR. DREDGE.

Sir,—In answer to the letter of Mr. Dredge, published in your Magazine of 31st of December, to which my attention has this moment been called, I shall be obliged if you will do me the favour to insert the whole of the paragraph of my Preface, (p. xvi.,) in which I have spoken of the suspension-bridge, together with the appended note.*

I make *no claim*, you will perceive, to having first suggested or demonstrated the principle, that "the section of the chains should diminish from the points of suspension to the centre."

To have done so would have shown great ignorance of the history of practical science. In the *Phil. Trans.* for 1826, this principle is fully stated and discussed by Mr. Davis Gilbert. A table is even given by him to facilitate its application; and again by Mr. Hodgkinson, in a paper referred to in my Preface, and published in 1831. Again I find it in the Analytical Statics of the Rev. Dr. Whewell, published in 1833. It was from these writers, and not from Mr. Dredge's bridge, that I derived my knowledge of it; and I think it likely that it may be found recorded in theoretical works of a yet earlier date.

I do, indeed, claim (although I have nowhere in my work specifically stated that claim) to have been the first to develope, *completely*, that law of the variation of the section of the chains, and of their curvature, which is consistent with the greatest economy of the material of the structure, under its ordinary form.

Whilst preceding writers have either modified the conditions of the question, or, deterred by its analytical difficulties, have not proceeded beyond that point at which it may be solved by approximation, my inquiries have been pushed on to the determination of formulæ expressing (in comparatively simple terms) the equation to the curve and the section of the chains. When applied to such cases as occur most commonly in practice, the latter formula shows the variation of the section not to be rapid or considerable.

I trust that I have sufficiently cleared myself of the imputation of "*borrowing another's ideas without acknowledgment.*"

Whenever a second edition of my work shall be called for, I will take care to institute a fuller investigation into the merits of Mr. Dredge's bridge. In the

* The paragraph and note are as follows:—

"In treating of rupture by elongation, I have been led to a discussion of the theory of the suspension-bridge. The question, so complicated when reference is had to the weight of the roadway and the weights of the suspending rods, and when the suspending chains are assumed to be of uniform thickness, becomes comparatively easy when the section of the chain is assumed so to vary its dimensions, as to be every where of the same strength. A suspension-bridge thus constructed is obviously that which, being of a given strength, can be constructed with the least quantity of materials; or, which is of the greatest strength, having a given quantity of materials used in its construction.*

"* That particular case of this problem, in which the weights of the suspending-rods are neglected, has been treated by Mr. Hodgkinson, in the fourth volume of the "Manchester Transactions," with his usual ability. He has not, however, succeeded in effecting its complete solution."

mean time, I cannot but regret the expressions which have given him pain.

Perhaps you will permit me to avail myself of this opportunity to correct an error into which you have been led, (p. 523,) by an observation in my Preface. The principle which I have employed, in treating of *the pressure of earth*, is that of Coulomb; but the whole method by which I have investigated the *stability of the revetement wall* sustaining that pressure is new to science.

Again, in respect to the arch, I have made no reservation whatever in favour of the old theory of the arch, as taught by Attwood, Hutton, Whewell, &c.; but only in favour of that old principle which neglects the consideration of the adhesive properties of the cement, and constructs the arch so strongly, that it would stand without mortar. My own calculations are founded on this principle.

My theory of the arch is different, *in every other respect* than in its *results*, from that of Coulomb.

Your very obedient servant,
HENRY MOSELEY.

Wandsworth, January 9, 1843.

WATERLOO BRIDGE—HIGH AND LOW TOLLS.

Sir,—Thinking it may be a matter of some interest to the public to know the effect of lowering the *foot tolls* at Waterloo Bridge, I herewith send you a statement, (omitting shillings and pence,) taken from their toll-book for the eight years preceding the reduction from one penny to one halfpenny, and also for the subsequent year and a half, up to August last. From this it will be seen that a loss has been sustained, in the three last half-years, of 1,123*l.*, as compared with the three last corresponding half-years, previous to the reduction, being 748*l.* per annum; exclusive of a probable additional loss of about 120*l.* in these three half-years, as the foot tolls were annually increasing at the rate of about 80*l.* per annum, on an average of 7 years previous to the reduction; and would, no doubt, have continued to increase at that rate, if the tolls had not been lowered.

I am, Sir, &c.,
A PROPRIETOR AND ANNUITANT.

London, January, 1843.

Statement of Foot Tolls taken at Waterloo Bridge.

		£	
½-year ending	Aug. 1833 ...	4861	
„	Feb. 1834 ...	4776	
„	Aug. „ ...	5092	
„	Feb. 1835 ...	4788	
„	Aug. „ ...	5006	
„	Feb. 1836 ...	4703	
„	Aug. „ ...	5090	
„	Feb. 1837 ...	4831	
„	Aug. „ ...	5155	
„	Feb. 1838 ...	4918	
„	Aug. „ ...	5353	
„	Feb. 1839 ...	4963	
„	Aug. „ ...	5260	15657 penny tolls
„	Feb. 1840 ...	5057	
„	Aug. „ ...	5340	
„	Feb. 1841 ...	4855	
„	Aug. „ ...	4807	14534 halfpenny tolls.
„	Feb. 1842 ...	4636	
„	Aug. „ ...	5091	
			1123 loss in 3 [half-years.

[It is a singular thing, certainly, and contrary to general experience, that in this instance a reduction of toll should not have been productive of any increase in the number of passengers. We do not see how the conclusion can be resisted, that there is a limit to the influence of cheapness, even; and that, in this case, that limit must be the original penny. The case of the proprietors of this noble structure was hard enough as it stood, without the aggravation of this halfpenny wise and pounds foolish measure.—Ed. M. M.]

ANTAGONIST ESSENCES—"Z.'S" THEORY OF PHOTIC FLUIDS.

Sir,—I am well aware that your space is too valuable to be wasted in idle controversy; but I hope that the remarks I am about to make on the letter of your correspondent, "Z.," (p. 6) may not exactly be considered as coming under that head. He says that he "has devoted many years to the endeavour of tracing the connexion of photic matter with the elements;" and I should, therefore, not presume to discuss *facts* with him, as he is, no doubt, infinitely stronger on that point than a student like myself can pretend to be: but his letter shows that he is prosecuting his researches on a *principle* which I think likely to prevent his ever attaining to any satisfactory result. I allude to the principle of "antagonist essences," which I had supposed entirely obsolete, but which he evidently recognizes, as he talks of "latent cold," as well as "latent heat;" and of darkness as "a vivid predominance of negative," whilst light is "a predomi-

nance of positive" photic fluids. I am sorry to be unable to refer, at the present moment, to any of the numerous treatises in which this idea is ably combated; but let me ask "Z." why he should encumber his admirable theory of fluids,

"Each within each, old Nature's changeless law,"

with any thing so *unnecessary* as this duplicate machinery? It is considered unphilosophical for the pioneers of science to *suppose* any cause, or combination of causes, with which we are *not* acquainted, whilst those with which we *are* acquainted suffice to explain the effects. Now, we are *not* acquainted with any "antagonist essences." We know that the presence of water produces the effect we call *wetness*; but I do not think any one ever considered it necessary to *suppose*, and I am sure no one ever *discovered*, any opposing element to account for the opposite effect, "*dryness*;" on the contrary, we consider it to arise from the absence of water. Now, let us apply this knowledge which we derive from what is within our reach, to what are at present out of our reach, heat and light—and, as they are supposed to be similar to water in one respect, fluidity, we are fully authorised to infer, while facts do not contradict us, that they may be similar to it in others. Let us suppose darkness to be the absence of light, and coldness of heat—are there any facts that can contradict such a theory? We hear of "darkness spreading," and this looseness of language has probably contributed to the idea of darkness being a substantive entity, not a mere negation. But has no one ever seen "dryness spreading?" Has no one ever looked on the pavement after a shower, and seen, first, a little speck of white stone make its appearance, then a larger spot, and then, by slow degrees, the spots increase and increase till they run into one another, and all vestige of damp disappears? Yet, in this case we merely imagine that the one agent, water, has retired before other causes, air, heat, &c., not that any second agent, dryness, has stepped in to drive it out of the field. Why then should we invent an antagonist principle to account for the effect, when heat or light retires before some other elemental agent? Surely the absence, more or less complete, of one single cause will be sufficient to explain all known phenomena of each of these duplicate effects, and if so, why suppose a second? And adopting "Z.'s" idea of atomic vibration being the radical cause of all elemental changes, let us suppose such vibration in some imponderable fluid to constitute light, then quiescence of the same fluid would be darkness: and as absolute darkness is probably not within our scope (if indeed existent at all,) then the small degree of vibration which is sufficient to affect our eyes, and which, therefore, we look upon as quiescence or darkness, may be best suited to certain photic effects as a very low degree of galvanic energy is to certain chemical effects. The same may be said of heat and of electricity (or galvanism), and there certainly is no reason why they should not owe their origin to three distinct fluids (which would be the theory of "Z," if he could persuade himself to resign his antagonist essences,) but at the same time, there is such an intimate connexion between them that I cannot help looking upon them as three different effects of one and the same cause acting under different circumstances. I will not, however, enter upon this subject, as my intention was only to warn your young readers against what I consider so erroneous a notion as that of "antagonist essences," and, if possible, to induce your correspondent "Z." to get rid of so cumbersome and injurious an appendage to his otherwise clear and philosophical theories: but if you should deem this worthy of insertion, I may perhaps some day give you a sketch of my ideas respecting the unity of all imponderable agents, whenever they are sufficiently elaborated to be worthy the attention of your readers.

I remain, Sir, your obedient servant,

COGITO.

WHITWORTH'S SELF-LOADING CART, OR STREET-SWEEPING MACHINE.

[By the Inventor.]

The Self-loading Cart has been lately brought into operation in the town of Manchester, where it has excited a considerable degree of public attention. It is the invention of Mr. Whitworth, of the firm of Messrs. Joseph Whitworth and Co., engineers, by whom it has been patented, and is now in process of manufacture. The principle of the invention consists in employing the rotary motion of locomotive wheels, moved by horse or other power, to raise the loose soil from the surface of the ground, and deposit it in a vehicle attached.

It will be evident that the self-loading principle is applicable to a variety of purposes. Its most important application, however, is to the cleaning of streets and roads. The apparatus for this purpose consists of a series of brooms suspended from a light frame of wrought-iron, hung behind a common cart, the body of which is placed as near the ground as possible, for the greater facility of loading. As the cart-wheels revolve, the brooms successively sweep the surface of the ground, and carry the soil up an inclined plane, at the top of which it falls into the body of the cart.

The apparatus is extremely simple in construction, and will have no tendency to get out of order, nor will it be liable to material injury from accident. The draught is not severe on the horse. Throughout the process of filling, a larger amount of force is not required than would be necessary to draw the full cart an equal distance.

The success of the operation is no less remarkable than its novelty. Proceeding at a moderate speed through the public streets, the cart leaves behind it a well-swept track, which forms a striking contrast with the adjacent ground. Though of the full size of a common cart, it has repeatedly filled itself, in the space of six minutes, from the principal thoroughfares of the town before mentioned. This fact, while it proves the efficiency of the new apparatus, proves also the necessity for a change in the present system of street-cleaning.

The state of the streets in our large towns, and particularly in the metropolis, it must be admitted, is far from satisfactory. It is productive of serious hindrance to traffic, and a vast amount of public inconvenience. The evil does not arise from the want of a liberal expenditure on the part of the local authorities. In the township of Manchester, the annual outlay for scavenging is upwards of 5,000*l.* This amount is expended in the township alone. In the remaining districts of the town the expense is considerable. Other towns are burdened in an equal, or still greater proportion. Yet, notwithstanding the amount of outlay, the effective work done is barely one-sixth part of what would be necessary to keep the public streets in proper order. In the district before referred to, they were a short time ago distributed into the following classes, according to the frequency of cleaning them:—class A, once a week; B, once a fortnight; C, once a month. It may be safely asserted, that all these streets should be swept, at least, six times oftener. The main thoroughfares, as well as the back streets and confined courts, crowded with the poorer part of the population, absolutely require cleaning out daily. But the expense already incurred effectually prevents a more frequent repetition of the process. The expensiveness of the present system, in fact, renders it altogether inefficient; nor is there any chance of material improvement in this important department of public police, unaccompanied by a corresponding reduction in the rate of expenditure.

Before proceeding to show in how remarkable a degree the self-loading cart is adapted to promote both these objects, it may be proper to notice an objection which has been urged against it, as calculated to deprive of the means of livelihood the numerous class of persons now employed in scavenging. The sequel will furnish an answer to this objection, which probably every reader will consider satisfactory. It will show that the interest of all classes is concerned in a change of system. With a view, however, to meet the prejudice which might otherwise prevent certain parties from giving the subject a fair consideration, it may be premised that, among all the cases wherein existing interests have been affected by the introduction of machinery, there is not one in which the objection could carry so little force. The occupation of a scavenger is proverbially the lowest in the social scale, and is universally regarded with a sentiment of compassion for those who have the misfortune to hold it. It is often the compulsory lot of paupers; and there is sometimes extreme hardship in the public exposure. When held by independent labourers, it cannot fail to induce a sense of degradation, akin to that which attends the receipt of public alms, and constitutes the essential hardship of parish relief. They have the toil and the wages of labour, without its reward. Nor is their present tenure of service secure. In bad times they must compete with paupers; both classes are sacrificed to the interests of the parish. In better times, both classes have the same opportunity, as they have a similar motive, to change, and thereby improve their condition. It ought, therefore, to be regarded as a circumstance in favour of the new system, that it will tend to restrict such an application of human labour. Nor ought it to be overlooked, that the ultimate effect, in all probability, will be, to provide a superior kind of employment for an equal number of men, when the benefit arising from the use of the patent apparatus has secured its general adoption, not only in towns, but upon all roads throughout the country.

The process of street-cleaning consists of three parts, viz., sweeping, loading, and carrying. Under the present system, these are entirely distinct operations. Each of

them constitutes a protracted and expensive process; and the two former absorb a large amount of human labour. By the aid of the self-loading cart, one horse is enabled to perform all the three processes, which are not only carried on simultaneously, but, as it were, blended in one operation; whilst each is so far simplified, as to render the combination less complex and protracted than the single process of either sweeping or loading by the present mode.

By the present mode of sweeping, the dirt is first moved from the centre to the sides of the street, and there collected into heaps for convenience in loading. An immense amount of time and labour is thus consumed; the mass of dirt being moved over a wide extent of surface, and the operation of cleaning continually retarded by the accumulation. It is calculated that each particle, on the average, moves through twenty feet of space before the operation of loading commences, and that the preparatory sweeping for each load consumes the greater part of a day's labour.

Here the advantage of the patent apparatus is self-evident. It entirely supersedes the whole process just referred to. The dirt, instead of being swept from one part of the street to another, is swept at once into the cart, and the street is cleared effectually. The operation of sweeping, in fact, merges into that of loading, and both are performed without the intervention of human labour. When going at the rate of only 2 miles per hour, with brooms 3 feet wide, the patent apparatus will clean nearly 60 superficial square yards per minute. This is about the average rate of work done by 36 men. Supposing the apparatus to work 5 hours per day, it would clean 18,000 yards, equal to the performance of 18 men.*

While the apparatus is thus calculated to abridge human labour, it will have the effect also of reducing the number of carts and horses now required to perform a given quantity of work. The time at present occupied in loading and carrying is considerable, in consequence of those operations being performed under very unfavourable circumstances. That of loading must be suspended during the progress of the cart from one station to another, and, consequently, is perpetually interrupted. Horse and men are stopped and started, alternately, at short intervals, whereby a continual waste is occasioned, both of time and force. The operation of the self-loading cart, on the contrary, is uniform and uninterrupted. Hence, though taking less in width, it will go over double the extent of surface included in the progress made by the present cart during the same time. Moreover, the diminished time occupied in loading is made available also for the purpose of carrying. By the present mode, the cart must stand idle while being filled; whereas the patent cart not only combines the operations of sweeping and loading, but performs both in the act of moving forward to the place of deposit. Nor is this all; it also economizes the time now spent in carting away and returning empty. Under the present system, owing to the great width of surface from which the sweepings are collected, the cart cannot travel far without being filled, and hence the time is principally occupied in carrying merely. Probably two-thirds of the whole time of carts, horses, and drivers are thus consumed, even where the places of deposit are adjacent. But the patent cart, taking less in width, (as before observed,) will proceed proportionally further before it is full. If the street be twenty yards wide, (the brooms being one yard,) it must go ten times further, and would reach a distant point by the time it was completely filled. Hence, it may be practicable to make such provision for deposit within or near the district, as will save all the time now consumed in carrying. A very moderate number of depôts would suffice for this purpose. If the streets were kept clean by frequent sweeping in dry weather, the yards might be advantageously placed more than a mile apart, and the cart, passing from one to another, would continually carry on its threefold operation. If the requisite number of depots could not be provided within or near the district, the apparatus might still be kept in continual action, by being transferred from one cart to another. It forms of itself a distinct and complete machine; and nothing more would be necessary for the above purpose, than to detach it from the full cart and apply it to an empty one.

Under any circumstances, it will have the effect of reducing the number of carts and horses now required for a given effect, besides doing all the work in sweeping and loading. It might be supposed, from the extra duty thrown on the horse, that an increase of horse-power would be necessary; but it is to be remembered that, under the present system, the horse works at a great disadvantage: his force is spent in alternately starting and stopping, standing idle, and drawing the empty cart. Supposing such provision made for deposit as would keep all the carts constantly occupied in sweeping, two horses might be allowed to

* In the township of Manchester, 22,000,000 yards were swept during the year 1841. 60 sweepers and 20 carters were employed, of whom, say 67 were constantly occupied in sweeping or loading. This would give 1,000 yards per man per day. The labour of paupers is found not to be so effective.

each, by way of relay for one another; but this would scarcely be necessary under other circumstances.

The amount of human labour necessary to give full effect to the patent apparatus is extremely limited. A driver will, of course, be required for each cart; also, a man to attend each yard; and a third to keep open the grids, and clear the gutters, by sweeping their contents within the range of the cart brooms. For the latter purpose, one man to each apparatus would be sufficient.

Besides the direct economy of manual labour and horse-power, the use of the self-loading cart will be attended with other advantages, not unworthy of notice. Owing to the complication of the present system, it is unwieldy in the management. The different processes, though distinct, are mutually dependent, and must be adjusted to each other. The number of sweepers must be in a certain proportion to the number and return of the carts, that the operation of loading may follow immediately on that of sweeping. It is true that this object is rarely accomplished; but the mere attempt, which is compulsory by fine, involves a superfluous outlay, and tends to perplex the whole management. The improved system will be entirely free from this cause of embarrassment, each cart acting independently, and having in connexion with itself all the necessary accessories.

Again, under the present system, it is highly inconvenient to clean locally, according to the actual state of the surface. In order to clean a part of the street, it is necessary to sweep the whole, though a considerable portion of the surface may not require the operation. It is towards the centre that the dirt chiefly accumulates, while the sides remain comparatively clear, until, by the perverse operation of the present method, the sweepings are collected there, to the great annoyance of passengers. The self-loading cart, by passing occasionally through the street, over the more central parts, will tend to preserve it in an uniform state throughout.

The mutual obstruction created to scavenging operations and public traffic is the source of much inconvenience under the present system. This is so great, that in the metropolis it is necessary to clean the main streets during the night. In this respect, the patent cart possesses an important advantage. It will pass through the most crowded thoroughfares without meeting or causing obstruction, doing its work as perfectly as if the street were empty. The importance of this circumstance is greater than would at first sight appear. In the principal thoroughfares, a vast quantity of manure is continually deposited; and, if it could be taken up immediately, not only would the main streets be kept clear, to the great benefit of traffic, but the untrodden manure would become valuable for agricultural purposes. By a little attention in sorting and mixing with ashes, the sweepings now taken from the streets are rendered saleable for manure. But, of the matter deposited, which constitutes the essential part of street manure, one-half is removed by a numerous class of persons who now make it a trade, and the other half is much trodden and depreciated before it can be collected. The diligence with which these adventurers pursue the traffic, and the eagerness with which they rescue the newly-fallen product, is sufficient evidence both of its intrinsic and ephemeral value. The self-loading cart will accomplish completely what they can do only partially; and it will not be the least among the advantages resulting from its introduction, that it will rid the public streets of a class of persons in constant collision with the police, and whom their occupation seems to have a necessary tendency to demoralize. It is, then, in the most crowded thoroughfares that the patent cart will act with the greatest advantage—where it may be kept constantly plying to collect manure. For the same purpose it may be passed once, or oftener, in the day, through every street, following the track of the manure happening to lie there. By this method, the whole surface of each street would be cleaned periodically.

The diminished rate of expenditure, combined with the increased value of the matter collected, will secure the efficient operation of the new system, and render the constant preservation of cleanliness an object as easy of attainment as it is full of importance to the health and comfort of all classes. What greater public nuisance can exist than that created by a mass of filth lying exposed in the public thoroughfares? By accumulating there, it becomes universally diffused. It is propagated by every passenger, and carried into the interior of every dwelling, producing innumerable annoyances, from which it is impossible to escape. The air itself becomes impregnated with noxious effluvia, whereby the whole neighbourhood is rendered unwholesome. This is more particularly the case in confined situations, and in cellars and apartments on the basement story, which draw their supply of air from the surface of the street.

Were the evil subdued in its first origin, the remedy would be more easily applied, and the injurious consequences altogether prevented. If the streets were kept in proper order, the rain, as it fell, would have a

tendency to cleanse them; whereas it has now the frequent effect of rendering them impassable, while the matter to be removed is increased three-fold in quantity. In the opposite state of dry weather, the clouds of dust which arise are among the greatest annoyances to which passengers, or persons resident in adjacent dwellings, can be subjected. The happy invention of the watering-cart, which has contributed so essentially to the comfort and refreshment of populous towns, has its operation and effect impaired by the same cause.*

The evil is one which affects all classes, but more especially the poorer. In the confined streets, where they chiefly reside, the accumulation of filth becomes an aggravated physical evil, and the direct source of moral injury. The higher ranks of life are beyond the reach of this peculiar influence, but on the lower it operates with most baneful effect. It not only discourages habits of cleanliness, but renders their formation impracticable. Health and morals alike suffer in consequence. Some of these streets are rarely cleaned at all, although, from their closeness and the habits of the residents, they need it oftener than any others. The houses having no direct communication with the common sewer, the street is made the general receptacle for refuse. That the frequent cleansing of such streets is indispensably necessary to the public health, is clearly shown in the Report of Dr. Southwood Smith, on the Causes of Fevers in certain parts of the Metropolis. The patent cart, passing daily through these neglected places, will perform a most essential public service, and may lead to a moral reformation in the habits of the people.

There is another view of the subject, deserving of particular attention, which has not yet been alluded to, viz., the tendency of cleanliness to promote the durability of streets, and, consequently, to diminish the expense of repairs. This is so great, that even under the present system it would be decidedly economical to clean them oftener. When dirt is allowed to collect on the surface, the water is prevented from running off, and soaks down to the foundation, which, becoming soft, yields to the first pressure. The surface of the street is thus rendered uneven, and the injury, though slight at first, is continually augmented. Carriage and wagon wheels revolve in the hollow places with the violence of concussion. The soil underneath rises between the stones to the surface, causing a new settlement, and forming the principal part of the substance to be carted away. This shows how extremely false a policy it is to allow the dirt to collect in the first instance. In the end, a double quantity is produced, and must be removed, while the structure of the street, which otherwise might have lasted uninjured, is completely broken down. Satisfactory evidence in confirmation of this statement, is furnished by the tables of scavenging, published in the Reports of the Manchester Police Commissioners. In the year 1840, 16,000,000 superficial sq. yards were swept, and 37,000 loads of dirt removed. In the following year, the surface swept was 22,000,000 square yards, and only 30,000 loads were taken. The extent of sweeping was greater by 6,000,000 yards, while the number of loads was less by 7,000. The extra loads removed in the former year, must have consisted principally of water and sub-soil, of which the quantity, in the following year, was diminished by more frequent cleaning.

The expense now incurred in repairing streets, is considerably greater than in cleaning; and the economy which the improved system is calculated to effect under the former head, is no less remarkable than under the latter. But a still greater advantage, even in point of economy, will arise from the improved condition of streets, as affecting the draught of horses, and wear and tear of vehicles of all kinds. This is now so great, from the want of cleanliness and the bad state of repair, that the extra tax on horse power alone, if converted into money, would more than defray all expenses incurred in relation to both objects.

The subject has hitherto been considered only with reference to the streets of populous towns; but its application may be extended to all public highways throughout the country. What has just been stated, respecting the extra draught of horses and cost of repairs, applies more particularly to common roads. In the work of the late Lord Congleton (Sir Henry Parnell) on Roads, various statements are made bearing directly on these points: Among others the following—

Calling the draught on a broken stone road in a dry and clean state	5
That on the same road covered with dust, is	8
Ditto wet and muddy	10

In the same treatise, Lord Congleton observes, "A road should be scraped from time to time, so as never to have half an inch of mud upon it. This is particularly necessary to be attended to, when the materials are weak, for, if the surface is not kept clean, so as to admit of its becoming dry in

* The watering-cart was patented by the inventor, to whom it proved extremely valuable, chiefly through its introduction into London. The method previously adopted was, to form an artificial reservoir at the side of the street, and throw the water from scoops across the surface.

the intervals between showers of rain, it will be rapidly worn away," &c., &c.

The expense incurred throughout England during the year 1834, under the various Turnpike Trusts, as stated in the returns ordered by the House of Commons, amounted to 1,725,000. Of this enormous sum, the principal part was expended in cleaning and repairs. The proportions are not given. The practice has been, to employ men occasionally to clean the roads by scraping the mud to the sides; but, owing to the expense of the operation, it is very rarely repeated. The same cause has also prevented the removal of the scrapings, which, while they render a considerable portion of the road useless, serve to prevent the water from getting away.

An invention called the Road Machine has been lately patented, and is already introduced on many roads in various parts of the kingdom. It enables one man to do the work of several; but the scrapings are left at the side, as before.

The self-loading cart is equally adapted for cleaning roads, and sweeping paved streets. In the former application, it possesses all the advantages already pointed out in reference to the latter. The soil taken up may be deposited, either at stations along the road convenient for that purpose, or in the adjoining fields by preconcerted arrangement with the owners. There can be no doubt that the debris of most roads, especially where there is much traffic, would, if frequently collected, be useful as manure; or might be made so, by keeping and mixing with prepared matter.

The patent apparatus, by sweeping the road in the direction of its length, will have a tendency to repair, as well as to clean it. This is an advantage peculiar to the new method. When the scraper is drawn across the road it bears equally on the low parts and the high, which latter, form ridges, running lengthwise along the road. It consequently has little or no tendency to reduce the inequalities of the surface. But when the broad broom is made to act *along* the ridges, it bears not on the highest parts, and thereby tends to restore the surface.

The general condition of turnpike roads, and the necessity for their improved management, is thus referred to the Report of the Committee of the House of Commons, in 1819, on the public highways:—

"The importance of land carriage to the prosperity of a country need not be dwelt upon. Next to the general influence of the seasons upon which the regular supply of our wants, and a great proportion of our comforts so much depend, there is, perhaps, no circumstance more interesting to men, in a civilised state, than the perfection of the means of interior communication. It is a matter therefore to be wondered at, that so great a source of national improvement has hitherto been so much neglected. Instead of the roads of the kingdom being made a great national concern, a number of local trusts are created, under the authority of which large sums of money are collected from the public, and expended without adequate responsibility or control. Hence arises a number of abuses for which no remedy is provided; and the resources of the country, instead of being devoted to useful purposes, are too often improvidently wasted.

"Your committee are perfectly convinced, that leaving matters in their present state, is in the highest degree impolitic. They are of opinion, that a parliamentary commission ought to be appointed, to whom every trust should be obliged annually to transmit a statement of its accounts, to be audited and checked. Under the direction of such an institution, the necessary experiments might be tried, for ascertaining the best mode of forming roads, and the best means of keeping them in repair: the proper construction of carriages and wheels, and the system of legislative provisions, the best calculated for the preservation and improvement of roads. All these are points which cannot be brought to the state of perfection of which they are capable, without some attention on the part of the legislature, nor by committees of the House, occasionally appointed, however zealous in the cause. Such great objects, which would add millions to the national income, and would increase the comfort of every individual in the kingdom, can only be successfully carried through by a great and permanent institution, whose whole attention shall be directed to that particular object; and who would take a just pride in accomplishing some of the greatest benefits that could be conferred on their country."

Since the report was made from which the above extract is taken, the progress of railways has materially altered the bearings of the subject, but without detracting from the force of the remarks as still applicable to common roads. The immense advantages to be derived from railroads cannot be fully developed without the aid of a subordinate system of inter-communication, connecting their main lines with every district and minute section of the country, and thus rendering the organization complete.

Taking into consideration the public nature and great importance of the objects proposed by the introduction of the self-loading cart, as well as the almost unlimited extent to which it may be usefully employed, the patentees are inclined to regard the formation of a general company of shareholders,

as the most advisable course to adopt for carrying it into operation. They think that, by the patent right being lodged with a public company, various facilities would be afforded for working it advantageously to all parties concerned. They are fully aware, that some opposition is to be expected from interested and prejudiced persons, which they deprecate as calculated to retard the introduction of a great public benefit. The civic authorities of populous towns, it is hoped, will afford their countenance to an improvement so well calculated to promote the health and comfort of the people. Pointed allusion has already been made, both by the Metropolitan and Provincial Press, to the novel performance of the patent cart,—and more particularly, to the ancient grievance against which it is directed. More favourable auspices could not be desired for its introduction, than are afforded by the writers who have so ably exposed the inveterate evil universally prevalent throughout the country. When the facilities for improvement afforded by the self-loading cart are generally known, the public voice will loudly demand a change of system.

ENGLAND THE METROPOLIS OF INVENTION.

England, beyond all other nations, is rich in machinery and inventions. Whatever is, or is thought to be, of value amongst the devices of ingenuity or the results of scientific investigation, either originates here, or is soon made ours. We may search in vain for a richer spring of improvement than that which exists at home; and, to whatever, cause it may be ascribed, the foreign discoverer or inventor, if he attribute any value to his achievements, rarely thinks his fame or his profit duly secured, if they be not published in English periodicals, or protected by an English patent; and if perchance anything singular or effective has been left in obscurity, by the love of fame or profit, the curiosity of our countless travellers brings it into day. Here then, we are placed in the chief centre of observation; the accumulated devices of ages are at work under our eyes; ingenuity and research can add nothing to them which we may not instantly remark.

* * * * * *

We are not to suppose invention has done all its work. We know not, indeed, what its next achievement will be; to know that, would be the next thing to accomplishing it. But let us ask, what reason have we to suppose that invention is now exhausted, which did not exist sixty or seventy years ago? That which was then thought impossible, is now done in the common course of daily business. The twelve million pounds worth of cotton-wool we now take annually of America, was as far from all prudent probability fifty years ago, as ten times that amount is for a period of twenty years to come; and it is a consumption caused entirely by improvements in machinery, which have brought down the price and usage of cotton fabrics, from the means and fashion of the wealthy few, to those of the poor and toiling many. Nor have we an art or manufacture of any importance, which remains as it was in the latter half of the last, or even in the beginning of the present century. And at this day, under our own eyes, are arising, not merely inventions, but new arts, of the extent of whose future consequences we can only say, but we may say with certainty, that they must be exceedingly great.

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We have not long recovered from the surprize which seized us, when the skill and perseverance of our engineers and mechanists first brought about the recent splendid results of this kind. To bring the continent of America within a *certain* twelve days' sail from our shores, to make Liverpool but a ten hours' easy ride from London, to deliver letters in London before the end of the twenty-fourth hour after they were posted in Dublin, to reach Bombay in thirty days from Falmouth, and by modes of travelling which women and children may ordinarily use—these were the airy visions or broad jokes of times but just gone by, but are now our daily and unthought-of conveniences. All the lower modes of travelling have also partaken of the spirit of improvement; our sailing vessels emulate our steamers in despatch and punctuality, and our turnpike roads and coaches, long before they were hopelessly defeated as main trunks by the railroads, had received every improvement which science could suggest, or impatient rapidity demand. It is impossible that the effects of these better modes of transit should be confined to the principal lines on which they immediately operate; if the rivalry of steam compels New York "liners" to "put the best leg foremost," the style in which they do it will soon be found to prevail on the voyages to Australia and New Zealand; and now that twenty or twenty-five miles an hour is ordinary work in England, the colonist, if he know it, is likely to be less content with almost unpassable tracks, than when the distance from Portsmouth to London was a three days' journey for royalty.

Here too, as in manufactures, the spirit of invention is still at work: it is not content with bridging the Atlantic, and running 3,000 miles at a spell, in spite of formulæ and Dr. Lardner. There are at this hour

inventions in existence, which rigid demonstration seems to say will bring steam-voyages of 4,000 or 5,000 miles as much, at least, witin our power as are the present performances, and at a cost proportionately reduced. We say nothing of still more startling announcements, even that, before long, Calcutta will be, as to time, as near to London as Edinburgh was less than a century ago! and yet the talent and standing of the parties who say they hope to accomplish this, may go for something against the inherent, or rather the present, improbability of such a consummation. We mention not these matters to draw present faith to them, but to show, that after all which has been done, men's brains are busy about modes of locomotion; and except we can bring ourselves to believe that nature's secrets are all extorted, and her treasures all ransacked, we must conclude that this untiring scrutiny will bring out something, probably much, that even in this flying age we have not yet known.

We are already feeling the influence of more frequent intercourse with Canada and the United States; we are beginning to feel that of our improved transit to India. Scenes which a few years ago seemed to belong to a kind of fairy-land, beyond the range of every-day imagination, are now almost the staple of our familiar and daily talk; and undertakings which seemed beyond the bounds of prudent enterprize and ordinary means, have become matters of common business and jog-trot application. Much less ado is now made of a voyage to America, than formerly of one to Ireland; and to go to India is an affair as little formidable as, since the peace of Paris, it was to travel to the south of France. A Bengal Zemindar comes to England from curiosity, and finding, after a while, he has to attend to some affairs at home, he sets off in November, leaving word at his hotel in London he shall be back again in May. Now, let us remember, that, all the world over, the main rule of human action is *neighbour-measure;* let us take into account that the measure, moral and intellectual, of that neighbour will be oftenest and most nearly conformed to, whose wealth and power add most force to his example, and the impress of whose doings is most frequently repeated; let us be thankful, that in His wisdom and goodness, Providence has given the greatest amount of these inferior and adventitious influences, along with, and evidently for the help of, that example which, with all its faults, is at present the best the world can afford; and let us conclude from all, that the more perfect and rapid are our means of conveyance, the lighter and more economical of fuel our marine-engines, the safer and more sea-defying our steam-boats, the more frequent will be our intercourse with those portions of the human race which are behind us in knowledge and civilization, the more influential for good will be the fame of our strength and standing, the more impressive will be our example in manners, in morals, and in righteousness, and the more extended and successful will be our direct attempts to establish the dominion ot truth and peace.—*From an excellent article on Machinery and Engineering for the Colonies, in Fisher's Colonial Magazine for January.*

HYDRAULIC PRESS-WORK—SINGULAR PHENOMENA.

Sir,—Being lately at a manufactory in the country, I was, to my surprise, informed by the workmen, that one day having worked the hydraulic press upon the premises to nearly its estimated pressure, two hours after they had ceased pumping, the cistern of the pump burst, without being interfered with, which effect they attributed to the expansion of the water which they supposed had been compressed. Again, that frequently when the goods had been placed in the press at night and left until the morning, when the greatest pressure had been applied that they could safely do, the piston of the pump had been elevated in the course of the night, in some instances fully an inch, in others half an inch, but almost invariably there appeared to have been an increase of pressure during the night; and this the parties were certain of, as they had a great number of times marked the piston for the purpose of proving the fact. This effect also they attributed to the expansion of the water after compression.

I should like to see it satisfactorily explained, whence these effects arise, and at the same time, whether water can, under the above, or indeed any other circumstances, be compressed.

Your obedient servant,

N.

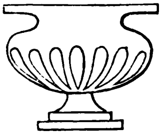
London, January 4, 1843.

TURNING COAL ORNAMENTS.

Sir,—I shall feel greatly indebted to any of your correspondents, who will give me, through the medium of your Journal, a little practical information respecting the art of turning various articles in canel coal. The points upon which I wish chiefly to be informed are: 1st., How is the coal prepared and shaped previously to its being placed in the lathe? 2nd, Is it turned as it comes from the pit, or does it undergo any prepa-

ration to toughen or soften it? 3rd, Is it best reduced from its rough state by the hand tools or by those of the slide rest? 4th, What is the mode of polishing the material when finished?

Should any of your correspondents favour me by replying to the above queries, perhaps they will still further oblige me by stating the best form of chuck for making a vase similar to the following, which I presume



could not be made with the assistance of the back puppet, as it would come so very near to the work; and also the best mode of reeding it similar to the example. Would you, Sir, still further add to the obligation, by informing me what are the best "Elementary Treatises" on turning in general?

Yours very respectfully,

SPINCOAL.

[The best work, when finished, will doubtless be that of Mr. Holtzapffel, the most eminent turner of the day, to the first volume of which we hope to pay our respects next week.—ED. M. M.]

ARCHITECTURE FOR THE POOR.

We are quite certain that one of the most powerful physical means of raising the moral state of our poorer fellows, and improving their condition generally, consists in the improvement and decoration of their dwellings. Order will not engender disorder, nor disorder, order: but its like; and the man who passes his time amidst inconvenient and tasteless arrangements, exposed to continual discomforts, and utterly unable to maintain an appearance of respectability, will gradually lose any desire to do so which he formerly felt, and find the external disorder result in a moral disorganization, lamentable in its consequences, if not fatal. "Slaves, through slavery, lose even the desire to be free:" so men, becoming accustomed to badly-constructed, inconvenient, and ill-arranged habitations, lose their perception of excellence and goodness; and are lowered, not merely in their physical state, but mentally. Watch the progress of many a respectable and industrious young couple, placed in one of the miserable hovels still dignified with the title of a labourer's residence in some parts of the kingdom—damp, ill-drained, ill-ventilated, pervious to the rain, and void of every thing which could make home happy. For a time, strenuous efforts are used to remedy the evils; but, as they are gradually found to be unconquerable, the wife, abandoning the task, becomes inevitably a slattern herself; habits even of decency are disregarded by the children; and the husband, finding no enjoyment in his own house, seeks it in the beer-shop, and becomes a drunkard and a desperado. On the other hand, a tidy, well-arranged dwelling leads to observances of better manners and feelings of self-respect, induces neatness and industry, and elevates in tone the character of all its occupants.

In no way can a landowner more advance the interests of society than by attending to the domestic residences of his tenants, whether in town or country; and we seriously call upon all those, who have not yet given consideration to this most important point, to set about doing so forthwith. A very great improvement, in many respects, has been effected in different parts of the country. Mr. Loudon, the estimable author of the "Arboretum" and the "Encyclopædia of Cottage Architecture," has contributed most largely to this desired end; but very much yet remains to be done. Mr. Edwin Chadwick's late excellent "Report on the Sanitary Condition of the Labouring Population of Great Britain," which ought to be in every one's hands, shows an amount of disease and demoralization, resulting from inattention in this respect, quite frightful to contemplate. This work contains a number of designs and suggestions for cottages, which cannot fail to be productive of improvement. The subject, however, at present, is but opened; as Mr. Chadwick observes, "Every detail of the materials with which the cottage is constructed, and the mode of its construction, deserve, and there is little doubt will obtain, most careful attention; for it is only by considering their comforts in detail that they can be improved, or the aggregate effect on the immense masses of the community can be analyzed and estimated."

Some of the chief points to be considered in the construction of residences for the poorer classes are, complete ventilation and perfect drainage; walls of such a nature as to prevent sudden alternations of temperature; a roof to supply the same condition, with absence of all matter likely, in decaying, to generate unwholesome gases; a sufficient elevation above the ground to prevent dampness; and floors of such a material as, while it may be a bad conductor of heat, will admit of washing without long retaining moisture. A plentiful supply of water, and an advantageous mode of warming the house, are also most important points, and the whole

must further be considered with the strictest regard to economy.

The amount of improvement in the public *health*, that has in all cases followed ameliorations in the dwellings of the poor, is so great, as would hardly be believed by any at first sight. Even in this respect, then, all have a personal interest in promoting it; sufficiently great, it might be believed, to induce their strenuous aid. But there are higher motives than merely personal fears, as we have already seen, and to these we would rather trust for arousing public feeling. We would, too, go further than simply providing the labourer with comforts: we would furnish him with *adornments*—we would make his home, ("there is a magic in that little word,") not merely tidy, but tasteful, and endeavour to hang upon its walls a few fine prints, to work silently, but surely; believing thoroughly, as we do, that the beautiful and the good are very closely connected, and that if you improve taste, you go very far towards increasing virtue.—*From an Article by* Mr. George Godwin, Jun., *in the "Art-Union" for January*, 1843.

A LESSON IN PUDDING BOILING.

Sir,—Being a reader of your valuable publication, you will oblige me if you will be kind enough to insert the following, as I trust it will not be wholly uninteresting to some of your many readers.

A short time since, I was dining with a lady, when a pudding was brought to table, the paste of which was what is commonly termed "heavy," or "doughy;" this, the lady remarked, was occasioned through the carelessness of the servant boiling it with the pot-lid closed down. I smiled, at the time, at this explanation; but, being assured of its correctness, I made up my mind to ascertain whether it really was a fact, or not. I have since made numerous inquiries amongst the ladies: some, I found, were well aware that such a result would follow; but the majority had never heard of it before, and laughed at the idea that such should be the case.

I will now endeavour to substantiate the lady's observation, and show that there is some philosophy even in the boiling of a pudding. In the first place, we know that water boils in an open vessel when it reaches the temperature of 212° Fahr. In a closed vessel, or vacuum, water boils at 172°, 40° of heat lower than when it is exposed to the atmosphere.

Now, if a pudding is placed in a pot, the lid of which is closed, the heat soon drives out the air, and a more or less perfect vacuum is formed, the water boiling at a temperature of about 172°. Now, I imagine a temperature of 212° of heat is necessary to effect that change in the paste which is essential to its "lightness." Persons who are in the habit of making paste for the use of the bookbinders, and for other purposes in the arts, know very well that it never acquires a proper consistency until it has acquired a temperature of 212°, or the boiling point.

I am, Sir, yours respectfully,

T. B. Lanadives.

THE "NOVELTY" STEAMER.

Sir,—In your last Number there is a communication from Mr. Wimshurst, regarding the merits of the "*Novelty*" steam-boat, or to use his own phraseology, steam ship, since none were worthy of the name until the appearance of the above vessel. Now, Mr. Editor, being another "plain unlettered" individual, and one who wishes to compare the merits of the different plans made public in your Journal, I think it would greatly assist others of your readers as well as myself, if your plain correspondents would become still plainer, and give *all* the facts in their communications. Such, for instance, as the distance run (a measured one), the time occupied in performing it *with* and also *against* the tide, whether with the assistance of the sails, and if so, which of them, and the state of the wind at the time, the pressure of steam in the boilers, and although last not least, a *correct* account of the consumption of fuel. If these had been added to Mr. Wimshurst's communication, it would, in my humble opinion, have greatly assisted the inquirer; and, *facts* being "stubborn things," it would leave it out of the power of individuals to doubt the correctness of Mr. Wimshurst's statements. There is an old saying, that "north country vessels sail quickest in the dark," or when not seen by any other party; such is not the case, I should hope, with the foregoing vessel, but certainly whenever I have seen her, her speed did not realize 8½ miles per hour, *through the water*. Perhaps Mr. W. has omitted *deducting* the distance the vessel was carried by the *tide*, which I am induced to think he has, as that subtracted from the 8½ miles gives the speed of the *Novelty* I think correct. In all experiments I would also strongly recommend the use of Massey's log, as that instrument gives the distances *through the water*, without any reference to tide. Feeling greatly interested in this newly resuscitated power, and wishing to see it compared fairly with the common paddle-wheel, I hope Mr. W.

will oblige by supplying, through your valuable work, the foregoing *omissions*, for the benefit of your numerous readers, as well as for

Sir, your obedient servant,
STERNPOST.

P.S. In looking over again Mr. W.'s statement of the power of his engines, and comparing it with the rules adopted by engineers, I find they *rather* exceed 25 horse power. Thus,

$$13^2 \times \cdot 7854 = 132 \cdot 7 \times 20 = 2654$$

2 ft. 4 in. $\times 55 \times 2 = 256 \cdot 8 \times 2654 = 681547 \cdot 2 \div 33 \cdot 000 = 20 \cdot 65$ or $41 \cdot 30$ as the combined power of both engines. Now, Mr. Editor, if the foregoing is correct, the results do not differ so widely as Mr. Wimshurst states, from the Archimedes; for I find, on referring to your work (vol. iv. p. 431), that Tredgold gives the following as the increase of power required for an increased velocity:—a vessel propelled 6 miles per hour with 43 horse power, must, to accomplish 10 miles, have her power increased to 200.

Blackwall, January 11, 1843.

ABSTRACTS OF RECENT AMERICAN PUBLICATIONS.

[Selected and abridged from the *Franklin Journal* for October and November 1842.]

MACHINE FOR FOLDING AND MEASURING CLOTH. *Joel Spalding.*—The cloth to be folded by the above-named machine is first wound on to a roller which is placed in bearings in the upper part of the frame; from thence it is brought down to a table, or bed-piece, provided with two hinged retaining bars, one at each end, under which the cloth, as it is folded, is caught and held, alternately at opposite ends. There are two folding boards, one at each end, and which are hinged to pendulous levers. The end of the cloth being secured under one of the retaining bars, the edge of the folding-board, on that side, is pressed against it, and pushes it across the table to the other retaining bar, which is lifted up to receive, catch, and retain the cloth, whilst the folding-board on the other side performs the same operation. The pendulous levers, to which the folding-boards are attached, are so connected together, as that, whilst one board is folding the cloth, the other is being prepared for the returning operation.

IMPROVEMENT IN THE MORTISE LATCH FOR DOORS, CARRIAGES, &c. &c. *Leonard Foster.*—The bolt of this latch has a long slot towards its inner end, which fits into the square spindle of the knobs, so that it can slide on it, and its outer end be lifted up by turning the knobs. There is a thumb-knob attached to this bolt, on its inner sides the shank of which plays loosely in a mortise, in that part of the door through which it passes, the lower edge of the said mortise being provided with two or three notches, into which the shank of this knob fits. By this arrangement it will be perceived, that, by lifting the shank of this thumb-knob out of one of these notches, and pushing it, (together with the bolt,) to the second or third notch, the outer end of the bolt is pushed into the hasp on the jamb of the door, and thus locked. And there being no corresponding knob on the outside, it cannot be unlocked, or lifted out of the notch, except by a key, which acts upon it in the usual way; the shank of the small knob, and the notches in the mortise, answering the purpose of the common tumbler.

SELF-ACTING FEEDER, FOR SUPPLYING STEAM BOILERS. *Etham Campbell.* In this feeder the supply of water to the boiler is regulated by two floats, one in the boiler and the other in a feeding cylinder, or reservoir. The upper part of the boiler communicates with the upper part of the feeding cylinder by a pipe governed by a valve, connected with the rod of the float in the feeding cylinder, for the purpose of admitting the steam to press on the top of the water therein. The stem of this float is also in connexion with another valve which regulates the admission of water to the feeding cylinder, which is connected with the boiler below the water line, by means of a pipe provided with two lifting, conical valves, one of which is operated by a lever that is attached to the stem of the float in the boiler. When the reservoir has a sufficient supply of water, the float is borne up in it, which keeps the valve in the supply-pipe closed, and that in the steam-pipe open, thus admitting and equalizing the pressure of the steam on the water in the two vessels. In this condition the apparatus is in readiness to supply water to the boiler when it becomes necessary. When the water in the boiler sinks too low, the float following it, the valve in connexion with this float is opened, and as the other valve in the same pipe opens upwards, the head of water in the reservoir being higher than in the boiler, and the steam pressing equally on both, this valve is opened and the water flows into the boiler until it reaches the level of the water in the reservoir which closes the valves and stops the supply; and the discharge of the water from the reservoir causes the float therein to sink, and to close the valve in the steam pipe and open the one in the supplying-pipe.

NOTES AND NOTICES.

The Numeral Figures.—The types from which numerals are printed were, from the invention of printing till about 1785, formed so as to give heads and tails to the figures, in the manner which is always used in handwriting. At the period just named, Dr. Hutton introduced in his logarithmic tables what was then a new form, in which the figures were all of one size, having no parts above or below the others. This system of Dr. Hutton's gradually became universal, much to the regret of all who had to consult mathematical tables, who were glad to use French tables, in preference to English, on account of the superiority of heads and tails. In the mean time, it was found that, with figures all of a size, a larger type was necessary, to secure sufficient legibility, and this type gave facilities to that formation of thick and thin lines which distinguishes the larger numerals of the existing English press from those of all other ages and countries:

1234567890

It was generally admitted that both circumstances,—the sameness of size, and the swelling of the lines which compose the figures,—were unfavourable to legibility; but no steps were taken to restore the old type until lately, when some works were published in what was called the *French brevier*, being a type in which the heads and tails exist, and in which the thickness is as nearly as possible the same throughout. The Council of the Royal Astronomical Society, and the Superintendent of the Nautical Almanac, have recently come to the determination to restore the old form of the numerals in their respective publications, an example which is pretty sure to be followed in mathematical publications, and perhaps in others.—*Correspondent of the Athenæum.*

Manufacture of Oil of Vitriol from Iron Pyrites.—The manufacture of sulphuric acid and soda is carried on conjointly, in a factory at Belgium, in the following manner:—The residua of the roasted pyrites are mixed with an excess of sea-salt, having previously ascertained the contents of sulphate of iron contained therein. The mixture is then heated in an appropriate furnace, arranged so as to collect the muriatic acid. The sulphate of soda formed, is obtained by solution and crystallisation; the peroxide of iron remaining is separated by elutriation into two parts; the most finely divided is dried and mixed with grease or palm oil, serving as a lubricator for machinery, for which it is admirably adapted; whilst the coarser portions are made into balls, dried, and used as mineral iron for the puddling-furnace. In factories where soda is not made concurrently with sulphuric acid, in place of procuring the sulphate of iron from the roasted pyrites it will be more advantageous to distil these residua, the sulphate of iron being first dried, so as to obtain the fuming sulphuric acid of Northausen, as it is termed. It would be very easy to arrange the apparatus in such a manner that the sulphurous acid, arising from the decomposition of part of the sulphate of iron, should be conducted into leaden receivers or chambers. By such an arrangement, nothing would be lost, since the colcothar, or peroxide of iron, remaining after the process has been completed, is always available.—*Mining Journal.*

Deleterious Gas Detector.—An invention is described in the French papers which will, it is said, give such timely notice of the presence of deleterious gas in mines, or other places, as will enable persons to take the necessary precautions to guard against explosions. An explosion from the admixture of carburetted hydrogen with atmospheric air can only take place when the former exists in a certain and known proportion. When the quantity has reached or exceeded this point, the contact of a light instantly causes an explosion. The instrument recently invented has a sort of tell-tale to show the existence of danger, is simple, ingenious, and effectual. Connected with a chemical solution is a kind of float, nicely graduated, and attached to a counterpoise. The solution is of such a nature that it undergoes a change when acted upon by the admixture of carburetted hydrogen, and when saturated to a certain point the float changes its position, and acting in its turn upon the counterpoise, a spring is let loose, and strikes upon a bell or drum, giving out a loud sound, and thus indicating the presence of danger. This ingenious test is not liable to derangement, and the whole apparatus is comprised within a small compass, and of little cost. The solution can be varied so as to be adapted to every kind of deleterious gas.

Barker's Mill applied to Steam Navigation.—Mr. Less delivered a lecture on steam navigation, with a particular reference to the exposition of a principle proposed to be applied by Mr. Ruthven of this city, and for which he has taken out a patent. The lecturer gave a succinct statement of the history and progress of steam navigation, and remarked that the great obstacle to its extension was the imperfect nature of the paddle wheels. It was to obviate this imperfection that Mr. Ruthven had turned his attention, and his plan was sufficiently simple. It was to apply to the propulsion of the vessel the principle which was known as that adopted in "Barker's Mill." It consists of a tube, horizontal or upright, into the extremity of which another tube, crossing it at right angles, was fitted, and open at both ends. When water was introduced into the first tube, it naturally made its escape at the two ends of the angular tube, but in its escape it caused this tube to revolve; the water, as it escaped, sending the tube forward in an opposite direction to that by which it escaped, and this with a force proportioned to the pressure of the water. The principle, in fact, is precisely the same as that which causes the recoil in a gun when it is discharged. It had been attempted to be applied to steam navigation before, but had always failed—because, in the lecturer's estimation, the water was always discharged below the surface, which impeded its power of action. He illustrated this by experiments, which certainly showed that the discharge of the water, below the surface of other water, was not nearly so efficient as when it was discharged into the air. The mode of its application to the propulsion of vessels, was as we understood, by making apertures in the bows of the ship, through which the sea water would flow into pipes, and thus would be conducted to the place where the steam-engine was situated. There the water would escape by a large pipe running across the vessel and open at both ends, but with the apertures directed towards the stern, which, upon the principle referred to, would have the effect of sending the vessel forward. If it was wished to back the vessel, the apertures could be turned in the contrary direction; and if to stop her, they had only to be turned directly down towards the bottom, while the engine never ceased working. In this case, we understand, the use of the engine would be to discharge the water out at the two apertures with a high degree of pressure as the speed of the vessel would be in proportion to the rush of the water. A small model was exhibited without a steam-engine, which showed the soundness of the principle, by the small skiff sailing, backing, and even turning, in water. The lecturer considered that vessels propelled in this way would have more velocity than those propelled by the paddle, besides the great advantage of dispensing with that imperfect implement.—*Edinburgh Courant.*

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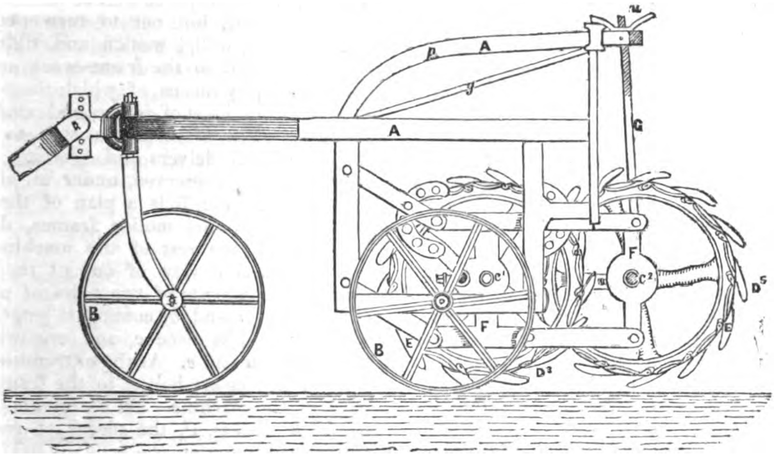
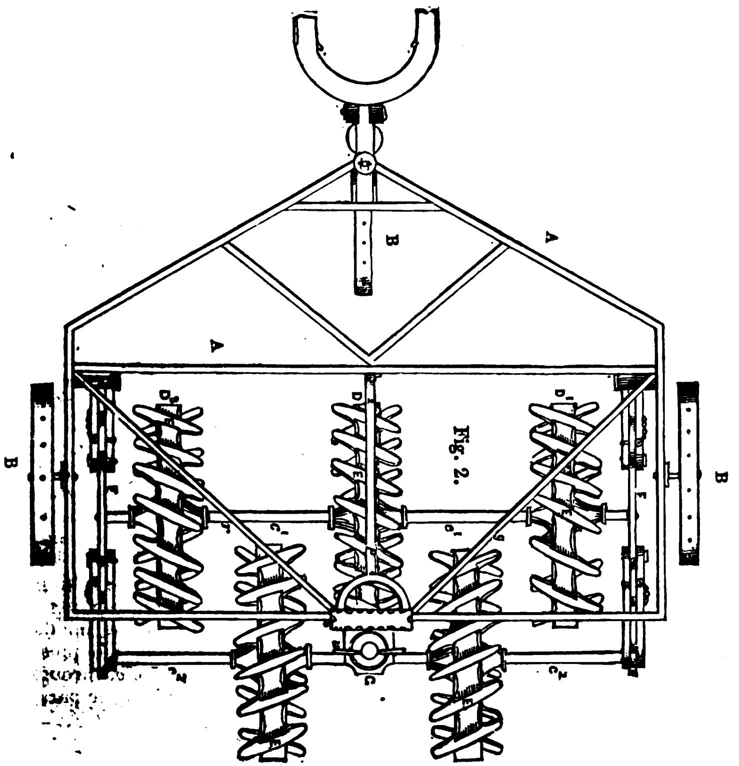
HALL'S PATENT DELVING AND CRUSHING MACHINE.

Fig. 1.





HALL'S PATENT DELVING AND CRUSHING MACHINE.

(Patent dated July 6, 1841. Specification enrolled January 6, 1842.)

The effects of the existing pressure on the agricultural interest, and of the greater pressure thought to be impending, is indicated by few things more strikingly than the great increase in the number of new machines, new implements, new manures, and new processes, by which it is seeking to strengthen itself to bear up against the tide of coming events. Never was there a time more rife of helps to good husbandry; and never, according to our farming friends, was there more need of them. We think they mistake the nature of " the ills they have," and greatly exaggerate those in prospect; but, be this as it may, there is no disputing that, so far as the march of improvement is concerned, the pressure is exercising a very salutary influence. Who knows but that it may be the means of convincing them, ere long, that their best dependence, after all, is on their own industry and skill?

The machine which we have now to bring under the notice of our readers is one of the most cleverly contrived and efficient of the kind which has ever come under our observation. The parallel motion and tilting frames are particularly ingenious, and capable of very extensive application to agricultural machines. The description which follows we extract from Mr. Hall's specification.

Fig. 1 is an elevation, and fig. 2 a plan of the principal parts of the machine; and figs. 3, 4, 5, 6, and 7, views of portions thereof, detached from the rest. A A A is the frame-work, and B B the wheels on which it is mounted. C^1 C^2 are two axles, which revolve in bearings in the parallel motion and tilting frames, F F, afterwards described, and have firmly attached to them the wheels D^1, D^2, D^3, D^4, and D^5. The front axle C^1 carries three, and the axle C^2, two of these wheels; and the two sets of wheels are so fixed, in respect to each other, that the wheel D^4 shall take into the spaces between the wheels D^1 and D^2, and the wheel D^5 into the space between the wheels D^2 and D^3. Each of these wheels is armed with delvers and crushers, E E, affixed in angular positions to their peripheries, in the manner shown in the end and side views of one of these wheels, figs. 3 and 4, and each delver and crusher is secured in its place by a swing joint, shown separately in fig. 4, which allows it to have a little play endways, as well as forwards and backwards, but not to turn over. F F are two parallel motion and tilting frames attached to the frame-work, one at each side, by means of which the parallelism of each set of delvers and crushers to the plane of motion, as well as of the two sets of delvers and crushers to one another, is preserved, under all circumstances. Fig. 5 is a plan of these tilting and parallel motion frames, detached from the rest of the machine; and fig. 6, a side view of one of them. Each frame consists of two pairs of parallel rods, *a* and *b*, connected lengthwise by a middle piece *c*, and crosswise by the bars *d* and *e*. At the extremities, *f f*, the frames are bolted to the frame-work of the machine. At the points g^1, g^2, h^1, h^2, and i^1, i^2, the pieces of each frame turn freely on the pins by which they are connected together. The axles C^1 C^2, which carry the wheels D^1, D^2, D^3, D^4, D^5, have their bearings in the cross-bars, *d e*, of the parallel motion and tilting frames, at the points *k* and *l*, so that the parallelism of the axles is preserved under all circumstances. G is a vertical screw-rod, used for elevating or depressing the axles of the wheels D^1, D^2, D^3, D^4, and D^5, which is secured at top to the frame-work by the stays *p q r*, and connected at bottom to the back axle C^2. The rod G works into and through a female screw in a nut *s*, which nut is gimbled into a boss *t*, attached to the end of the main stay *p*, by which gimbling of the nut the rod is enabled to accommodate itself to any angle at which the axle to which it is connected may be set. At the top of the rod there is a handle, *u*, for turning it round. As the bind axle C^2, with which this rod is immediately connected, is raised or depressed by the turning of the handle, a similar movement is transmitted to the front axle C^1, by means of the parallel motion and tilting frames F F, and the slotted quadrants *m m*, attached to the ends of the middle pieces *c c*. For, by passing the pins *n n*, attached to the chains *o o*, through any of the two holes or slots in the parallel rods

into the corresponding holes or slots in the quadrants *m m*, the two parts of the compound parallel motion are firmly united together, and any movement given to one axle is imparted to the other. From what has been stated, it will be readily understood that, previous to the setting of this machine to work, the delvers and crushers can be fixed so as to penetrate to any required depth into the soil, and that the arrangements for this purpose may be easily and quickly varied, according to circumstances. Motion is given to the delving and crushing wheels by the delvers and crushers acting against the ground, in a direction contrary to the line of draught of the horses or other animals employed to draw the machine. From the hind wheels revolving in the spaces between the front wheels, they not only serve to break up any clods or lumps which may have escaped, or been imperfectly acted upon by the front wheels D^1 D^2 D^3, but are also of great use in clearing away any earth or rubbish which may adhere to the delvers and crushers of the front wheels. The tines may be fixed at any

Fig. 3.

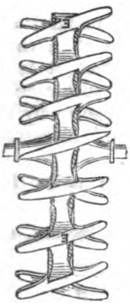


Fig. 5.

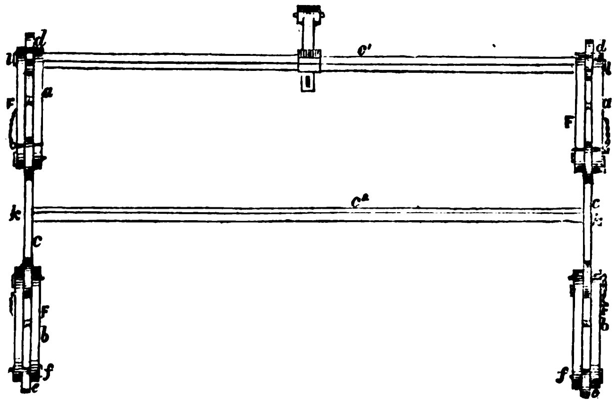


Fig. 4.

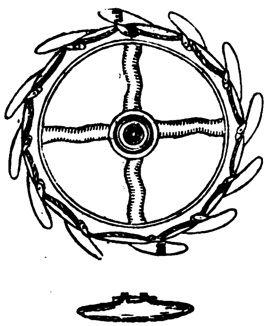
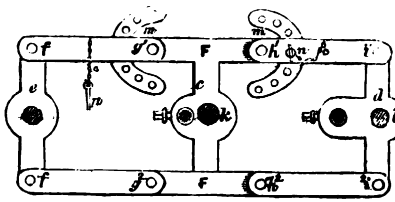


Fig. 6.



angle required in respect to the ground, by turning them to the required angle, and then passing the pins *n n*, attached to the chains *o o* as aforesaid, (see figs. 5 and 6,) through the holes or slots in the parallel rods and quadrants which fall in the line of that angle; or by shifting the connecting-pins, g^1 h^1 and g^2 h^2, forward or backward, for which purpose holes or slots are made in the top pieces *c c*, and thus shortening or lengthening the range of the upper parallel rods, as compared with that of the lower rods.

Single machines may be made on the same plan as the preceding, that is, with one set of delvers and crushers only.

The inventor describes, also, a harrowing machine, a rolling machine, and a double ploughing machine, (with two ploughs, making two furrows at one and the same time,) which are all modifications only of the double delving and crushing machine before described.

THEORY OF NUMBERS.

Sir,—May I crave space for a few remarks on the communication of a "Lover of Science," at page 8 of your present volume.

Proposition 9, chap. 1, of Barlow's *Theory of Numbers*, is, "The product of any two numbers is the same, whichever of the two is the multiplier; or, $a \times b = b \times a$." And a corollary is, that "the product of any number of factors is the same, in whatever order they are multiplied together." This proposition Mr. Barlow establishes by showing, that the equality of the products $a \times b$ and $b \times a$ depends upon that of other two products, $a^1 \times b$ and $b^1 \times a$, in which a^1 and b^1 are respectively less than a and b. The equality of these products, again, is shown to depend upon that of other two, whose factors are still smaller; and so on, until the whole is shown to depend upon the equality of two products, in which either the factors are equal to each other, or one of them is equal to unity. In the former case the equality of the products is evident, and in the latter it follows from the 5th axiom.

Now, this demonstration appears to me most satisfactory; and I do not see how, holding the place it does in Mr. Barlow's work, it could be shortened or simplified. Your correspondent, however, (whom, for the sake of brevity, I shall take the liberty of calling "L. S.",) thinks it "rather elaborate;" and proposes another, which, of course, he supposes not to be open to the same objection. I propose to show that L. S.'s demonstration, if free from the objection of being "elaborate," is liable to others of a much graver character; that, in fact, it is no demonstration at all, but a specimen of the logical vice familiarly known by the term "begging the question," or assuming the point to be proved.

"L. S.'s" demonstration is as follows:—*

"If a and b are the two factors, call $ab = x$, and $ba = y$; then $\frac{ab}{ba} = \frac{x}{y}$.

$$\text{Now, } \frac{ab}{ba} = a \times b \times \frac{1}{b} \times \frac{1}{a} = a \times \frac{b}{b} \times \frac{1}{a} = a \times 1 \times \frac{1}{a} = a \times \frac{1}{a} = \frac{a}{a} = 1 = \frac{x}{y};$$

whence, $x = y$, and $ab = ba$." Taking the expression $\frac{ab}{ba}$, "L. S." resolves it into the four factors, a, b, $\frac{1}{b}$, and $\frac{1}{a}$. But from nothing previously established is it known that the expression is resolvable into these factors. I grant that it is so resolvable; but our knowledge of this depends upon the establishment, amongst others, of the very proposition before us. Again, granting that these factors are such as will, by their continued multiplication, reproduce the original expression, how are we to know the proper order in which the multiplications are to be performed, so as to produce the desired result? For, at present, it is to be remembered, we do not know whether a change in the order of the factors will not produce a change in the value of the product. "L. S." gets over this difficulty in a very simple manner, and that is, by shutting his eyes to it. He assumes an order for his factors, and places their product *in this order*, equal to the original expression.

But, supposing all this to be correct, "L. S." again goes wrong. After placing his factors so as to indicate that they are to be multiplied *in a particular order*, he immediately proceeds to a partial multiplication *in another order*. He multiplies the second and third factors together, and places the product of the three factors, to which the four are thus reduced, still equal to the original expression!

It is needless to follow "L. S." farther. He has been misled by the want of a clear comprehension of the point to be proved, and of the conditions by which the mode of proof is necessarily restricted. Had the proposition admitted of such a mode of proof as "L. S." suggests, it is not likely that so acute a writer as Mr. Barlow would have overlooked it. I am

* It is rendered somewhat obscure in your pages by the figure 6 being several times printed for the letter *b*.

not one of those who would stifle inquiry by a mere reference to authority. We know that the ablest of men at times go wrong. Still, before calling in question the performances of a man of high character and established reputation, we ought to make very sure that the fault does not lie with ourselves.

I am, Sir, yours respectfully,

G.

Hermes-street, Pentonville,
January 14, 1843.

HOLTZAPFFEL'S BOOK ON TURNING.*

The art of turning is one very extensively pursued in this country both for business and pleasure; its uses, too, are manifold, and scarcely second to any in mechanical importance; yet, strange to say, there is probably no branch of art on which less has been written and published in our mother tongue. All the best works on turning are in the French language; the only English authors of note are Ibbetson and Rich—the former an old and frequent correspondent of the *Mechanics' Magazine*, which had the honour of giving to the world (as Mr. Holtzapffel very handsomely acknowledges) the first description of his admirable modification of the geometric chuck; and in our greatest English collection of books, the British Museum, there is not a single work on turning, either French or English, (with the exception of Rich's) of later date than 1724-7.

Of there being ample room under these circumstances for a complete English work on the subject (for both Ibbetson's and Rich's embrace but small portions of it) there can be no question; and among the persons most likely to do it well, we know of none so likely to unite the suffrages of all turners, both amateur and practical, as the living representative of the house of Holtzapffel, long the most eminent makers of turning tools and machines in this country. Mr. Charles Holtzapffel, the author of the work before us, states that he had made some beginnings in conjunction with his late much-respected father; but that after the death of the latter in 1835, he recommenced his labours on a new plan, of which he now presents the first fruits to the public. The most distinguishing features of this plan are its great comprehensiveness, and excellent methodical arrangement. Mr. Holtzapffel proposes to discuss in successive volumes, I. The materials used in turning, and the various modes of preparing them, as seasoning, hardening, tempering, alloying, &c. II. The principles, construction, and purposes of cutting tools, and the various processes used in the production of form, and embellishment of surfaces, as grinding, polishing, &c. III. The principles and practice of hand or surface turning. IV. The principles and practice of ornamental or complex turning. And V. The principles and practice of amateur engineering, embracing wheel and screw cutting, drilling, planing, &c. The work will thus include not only everything necessary to a perfect understanding of the art of turning in all its branches, but a vast body of valuable information having important relations to other arts as well as turning. Excellent as some of the French works are—the "Manuel du Tourneur" especially—they are likely to be quite eclipsed by this new production of our own country. The chief fault—if fault it can be called—of Mr. Holtzapffel' work will be its size; but this will be found remedied to a great extent by the judicious arrangement of the materials which he has adopted.

"From the systematic arrangement which has been attempted throughout the five volumes, it is hoped that instead of the numerous descriptions and instructions being indiscriminately mixed and scattered, they will assume the shape of so many brief and separate treatises; and will, in a great measure, condense into a few consecutive pages, the remarks offered under each head; a form that will admit of any subject being selected, and of a more easy and distinct *reference* and *comparison*, when the reader may find

* Turning and Mechanical Manipulation; intended as a Work of General Reference and Practical Instruction on the Lathe, and the various Mechanical Pursuits followed by Amateurs. By Charles Holtzapffel, Associate of the Institution of Civil Engineers, &c. To be comprised in 5 volumes. Vol. I., 457 pp., 8vo. Published for the Author, 64, Charing Cross, and 127, Long Acre.

it necessary—a facility that has been particularly studied. Each of the five volumes may be considered as a distinct work, and complete in itself. At the same time, it is to be observed that the first and second are written as accompanying volumes, and will have an index in common, so as to constitute a general and preliminary work; the addition to which of one of the other volumes will render the subject complete for each of the three classes of amateurs before referred to,* should the entire work be deemed too expensive."—Page 10.

The first volume of Mr. Holtzapffel's work, which is the only one which has yet made its appearance, is not likely, from the nature of its subjects, to be the best or most original; yet, nevertheless, it furnishes excellent earnest of those which are to follow. If we may judge of the whole from this specimen, we should say that there has seldom, if ever, appeared a work abounding more in new and sterling information—such information as only a person practically conversant, for a lifetime, with the matters of which he treats could furnish, and much of which you can meet with no where else. The author has drawn freely from a great number of sources, but not once, as far as we have observed, without frank acknowledgment; nor often without adding something valuable of his own, either in the way of confirmation or correction. Copying is in some cases rank robbery; but when Mr. Holtzapffel copies, it is to give a stamp of authority to coin which would not half so readily pass current without it.

The "Materials from the Vegetable Kingdom" are first treated of, the chapters on which are enriched by some valuable notes supplied by Dr. Royle, of the India House and King's College; then the "Materials from the Animal Kingdom;" and, lastly, the "Materials from the Mineral Kingdom."

We give a couple of striking specimens:—

Choice of Ivory.

"The choice of ivory in the tooth is admitted by the most experienced to be very uncertain; of course, for the purposes of turning, a solid cone would be the most economical figure; but as that form is not met with, we must be satisfied with the nearest approach that we can find to it, and select the tooth as nearly straight, solid, and round as possible, provided the other prognostics are equally favourable.

"The rind should appear smooth and free from cracks, and if the heart should be visible at the tip, the more central it is the better. By the close inspection of the tip, from which the bark is always more or less worn away, it may be in general learned whether the tooth is coarse or fine in the grain, transparent or opaque; but the colour of the exterior coat prevents a satisfactory judgment as to the tint or complexion of the ivory within.

"After the most careful scrutiny on the outside of the tooth, however, the first cut is *always* one of a little anxious expectation, as the prognostics are far from certain; and, before proceeding to describe the preparation of ivory, I will say a few words of its internal appearance when exposed by the saw.

"The African ivory, when in the most perfect condition, should appear, when recently cut, of a mellow, warm, transparent tint, almost as if soaked in oil, and with very little appearance of grain or fibre; it is then called transparent or green ivory, from association with green timber. The oil dries up considerably by exposure, and leaves the material of a delicate and generally permanent tint, a few shades darker than writing paper.

"The Asiatic ivory is of a more opaque dead white character, apparently from containing less oil; and, on being opened, it more resembles the ultimate character of the African; but it is the more disposed of the two to become discoloured or yellow. The African ivory is generally closer in texture, harder under the tools, and polishes better than the Asiatic, and its compactness also prevents it from so readily absorbing oil, or the colouring matter of stains when intentionally applied.*

"The rind is sometimes no more than about one-tenth of an inch in thickness, and nearly of the colour of the inner ivory; but occasionally it is of double that thickness, dark-coloured, and it partially stains the

* Who may be thus designated—Home-made Turnery Amateurs—Fashionable Amateurs—and Inventor Amateurs.—Ed. M. M.

"* I have retained the commonly received terms, *African* and *Asiatic* ivory, although the greater part of both kinds appears to come from Africa. Perhaps a more practical distinction would be for 'African' ivory, *transparent ivory*; and for 'Asiatic' ivory, *opaque ivory*."

outer layers. As we do not find all specimens of the most perfect kind, we must be prepared to expect others, especially amongst the larger teeth, in which the grain is more apparent; but it generally dies away towards the centre of the tooth, the outside being the coarsest; the regularity of the grain sometimes gives it the appearance of the engine turning on a watch case.

"In some teeth the central part will appear of the transparent character, the outer more nearly white; and the transparent teeth often exhibit, at the solid parts, white opaque patches, which are frequently of a long oval form. Amongst the white ivory, the teeth are often found to be marked in rings alternately light and dark coloured, these are called *ringy* or *cloudy*.

"In those teeth in which there appears a deficiency of the animal oil, the intervals between the fibres occasionally assume the chalky character of bone, and are disposed to crumble under the tools, unless they are very sharp; in this they resemble the softer parts of woods when worked with blunt tools; sometimes the ivory is not only coarse, but dark or brown, and the two defects not unfrequently go together.

"The cracks occasionally penetrate further than they appear to do when viewed from the outside, and more rarely a very considerable portion of the tooth is injured by a musket ball, although the gold and silver bullets, said to be used by the eastern potentates, are exceedingly scarce, or else transmuted into iron, of which metal they are commonly found, and less frequently of lead.* They generally lacerate the part very much, and a new deposit of bony matter is made, that fills all the interstices, encrusts the hollows, and leaves a dotted mottled mass, extending many inches each way from the centre, and which completely spoils that part for any ornamental purpose."†—p. 144.

"* I have only heard of two golden bullets thus found, the one Mr. Fauntleroy says was cut through by a comb-maker in dividing a tooth, and was in the possession of his uncle: the other was found by Mr Brain, its value was seventeen shillings.

"† The substance of the ivory is not in all cases thus injured by the balls, and Mr. Combe (Philos. Trans. 1801, p. 165,) explains in a very satisfactory manner, how a bullet may enter the tusk of an elephant and become embedded in the ivory without any opening for its admission being perceptible. This he elucidates on the supposition of the ball entering at the root, descending into the hollow, and being covered up by the growth of the layers, which are successively deposited upon the central vascular pulp, in the formation of the tooth according to the process commonly observed in similar cases. He cites an instance of a spear-head, seven inches long, having been thus embedded in the tusk of an elephant, from entering at the chin part near the skull of the animal."

Common examples of hardening and tempering steel.

"Watchmaker's drills of the smallest kinds are heated in the blue part of the flame of the candle; larger drills are heated with the blow-pipe flame, applied very obliquely and a little below the point; when very thin they may be whisked in the air to cool them, but they are more generally thrust into the tallow of the candle or the oil of the lamp; they are tempered either by their own heat, or by immersion in the flame below the point of the tool.

"For tools between those suited to the action of the blow-pipe, and those proper for the open fire, there are many which require either the iron tube, or the bath of lead or charcoal described at p. 241, but the greater number of works are hardened in the ordinary smith's fire without such defences.

"Tools of moderate size, such as the majority of turning tools, carpenter's chisels and gouges, and so forth, are generally heated in the open fire; they require to be continually drawn backwards and forwards through the fire to equalize the temperature applied, and they are plunged vertically into the water, and then moved about sideways to expose them to cooler portions of the fluid. If needful, they are only dipped to a certain depth, the remainder being left soft.

"Some persons use a shallow vessel filled only to the height of the portion to be hardened, and plunge the tools to the bottom; but this strict line of demarcation is sometimes dangerous, as the tools are apt to become cracked at the part, and therefore a small vertical movement is also generally given that the transition from the hard to the soft part may occupy more length.

"Razors and penknives are too frequently hardened without the removal of the scale arising from the forging; *this practice, which is not done with the best works, cannot be too much deprecated*. The blades are heated in a coke or charcoal fire, and dipped into the water obliquely. In tempering razors they are laid on their backs upon a clear fire, about half-a-dozen together, and they are removed one at a time when the edges, as yet thick, come down to a pale straw colour; should the backs accidentally get heated beyond the straw colour, the blades are cooled in water, but not otherwise. Penknife blades are tempered a dozen or two at a time, on a plate of iron or copper about 12 inches long, three or four wide, and about a quarter of an inch thick; the blades are arranged close together on their backs, and lean at an angle against each other. As they come down to the temper, they are picked out with small

pliers and thrown into water if necessary; others are then thrust forward from the cooler parts of the plate to take their place.

"Hatchets, adzes, cold chisels, and numbers of similar tools, in which the total bulk is considerable compared with the part to be hardened, are only partially dipped; they are afterwards let down by the heat of the remainder of the tool; and when the colour indicative of the temper is attained, they are entirely quenched. With the view of removing the loose scales, or the oxidation acquired in the fire, some workmen rub the objects hastily in dry salt before plunging them in the water, in order to give them a cleaner and whiter face.

"In hardening large dies, anvils, and other pieces of considerable size, by direct immersion, the rapid formation of steam at the sides of the metal prevents the free access of the water for the removal of the heat with the required expedition; in these cases a copious stream of water from a reservoir above is allowed to fall on the surface to be hardened. This contrivance is frequently called a 'float,' and although the derivation of the name is not very clear, the practice is excellent, as it supplies an abundance of cold water, and which, as it falls directly on the centre of the anvil is sure to render that part hard. It is, however, dangerous to stand near such works at the time, as when the anvil face, &c., is not perfectly welded, it sometimes in part flies off with great violence and a loud report.

"Occasionally the object is partly immersed in a tank beneath the fall of water, by means of a crane, slings, &c.; it is ultimately tempered with its own heat and dropped in to become entirely cold."

"Oil, or various mixtures of oils, tallow, wax, resin, &c., are used for many thin and elastic objects, such as needles, fishhooks, steel pens, springs, &c., which require a milder degree of hardness than is given by water.

"For example, steel pens are heated in large quantities in a tray within a furnace, and are then hardened in an oily mixture; generally, they are likewise tempered in oil, or a composition, the boiling point of which is the same as the temperature suited to the letting them down. This mode is particularly expeditious, and the temper cannot fall below the assigned degree. The dry heat of an oven is also used, and both may be made to serve for tempers harder than that given by boiling oil, but more care and observation is required for these lower temperatures.

"Saws and springs are generally hardened in the same manner in various compositions of oil, suet, wax, &c.,* which, however, lose their hardening property after a few weeks' constant use; the saws are heated in long furnaces, and then immersed horizontally and edgeways in a long trough containing the composition; two troughs are commonly used, the one until it gets too warm, then the other for a period, and so on alternately. Part of the composition is wiped off the saws with a piece of leather when they are removed from the trough, and they are heated one by one over a clear coke fire until the grease inflames; this is called '*blazing off*.' When the saws are wanted to be rather hard, but little of the grease is burnt off; when milder, a larger portion; and for a spring temper, the whole is allowed to burn away. When the work is thick or irregularly thick and thin, as in some springs, a second and third dose is burnt off to ensure equality of temper at all parts alike.†

"Springs and saws appear to lose their elasticity, after hardening and tempering from the reduction and friction they undergo in grinding, polishing, &c.; towards the conclusion of the manufacture, the elasticity is restored principally by hammering and partly by heating it over a clear coke fire to a straw colour; the tint is removed by very diluted muriatic acid, after which the saws are well washed in plain water and dried.

"* The composition used by an experienced saw-maker is two pounds of suet and a quarter of a pound of bees-wax to each gallon of whale-oil; these are boiled together, and will serve for thin works and most kinds of steel. The addition of black resin, to the extent of about one pound to the gallon, makes it serve for thicker pieces and for those it refused to harden before; but the resin should be added with judgment, or the works will become too hard and brittle. The composition is useless when it has been constantly employed for about a month; the period depends, however, on the extent to which it is used, and the trough should be thoroughly cleansed out before new mixture is placed in it.

"The following recipe is recommended by Mr. Gill:
'Twenty gallons of spermaceti oil;
'Twenty pounds of beef suet rendered;
'One gallon of neats-foot oil;
'One pound of pitch;
'Three pounds of black resin.
'These two last articles must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until the moisture is entirely evaporated, and the composition will take fire on a flaming body being presented to its surface, but which must be instantly extinguished again by putting on the cover of the vessel.'—Manufactures in Metal, Vol. I, p. 336. Lardner's Cyclopædia. See also page 311, ibid.

"† Gun-lock springs are sometimes literally *fried in oil* for a considerable time over the fire in an iron tray; the thick parts are then sure to be sufficiently reduced, and the thin parts do not become the more softened from the continuance of the blazing heat,

"Watch springs are hammered out of round steel wire of suitable diameter, until they fill the gauge for width, which at the same time ensures equality of thickness; the holes are punched in their extremities, and they are trimmed on the edge with a smooth file; the springs are then tied up with binding wire in a loose *open* coil, and heated over a charcoal fire upon a perforated revolving plate, hardened in oil, and blazed off.

"The spring is now distended in a long metal frame, similar to that used for a saw-blade, and ground and polished with emery and oil between lead blocks; by this time its elasticity appears quite lost, and it may be bent in any direction; its elasticity, however, is entirely restored by a subsequent hammering on a very bright anvil, which '*puts the nature into it.*'

"The colouring is done over a flat plate of iron, or hood, under which a little spirit lamp is kept burning; the spring is continually drawn backwards and forwards, about two or three inches at a time, until it assumes the orange or deep blue tint throughout, according to the taste of the purchaser; by many, the colouring is considered to be a matter of ornament, and not essential. The last process is to coil the spring into the spiral form, that it may enter the barrel in which it is to be contained, this is done by a tool, with a small axis and winch handle, and does not require heat.

"The balance springs of marine chronometers, which are in the form of a screw, are wound into the square thread of a screw, of the appropriate diameter and coarseness; the two ends of the spring are retained by side-screws, and the whole is carefully enveloped in platinum foil, and bound tight with wire. The mass is next heated in a piece of gun-barrel, closed at the one end, and plunged into oil, which hardens the spring almost without discolouring it, owing to the exclusion of the air by the close platinum covering, which is now removed, and the spring is let down to the blue, before removal from the screwed block.

"The balance or hair-springs of common watches are frequently left soft; those of the best watches are hardened in the coil upon a plum cylinder, and are then curled into the spiral form between the edge of a blunt knife and the thumb, the same as in curling up a narrow ribbon of paper, or the filaments of an ostrich feather.

"Mr. Dent says that 3,200 balance springs weigh only one ounce;* but springs also include the heaviest examples of hardened steel works uncombined with iron: for example, of Mr. Adam's patent bow-springs for all kinds of vehicles, some intended for railway use measure $3\frac{1}{2}$ feet long, and weigh 50 pounds each piece, two of these are used in combination; other single springs are 6 feet long, and weigh 70 pounds.*

"In hardening them, they are heated by being drawn backwards and forwards through an ordinary forge fire, built hollow, and they are immersed in a trough of plain water; in tempering them they are heated until the black red is just visible at night; by daylight the heat is denoted by its making a piece of wood sparkle when rubbed on the spring, which is then allowed to cool in the air. The metal is nine-sixteenths of an inch thick, and Mr. Adams considers five-eighths the limit to which steel will harden properly, that is, sufficiently alike to serve as a spring; and he tests their elasticity far beyond their intended range.†"—p. 247.

The volume is illustrated by upwards of three hundred wood-cuts, remarkable for their uniform accuracy and clearness.

"* The soft springs are worth 2*s*. 6*d*. each; the hardened and tempered springs, 10*s*. 6*d*, each. This raises the value of the steel, originally less than twopence, to 400*l*. and 1600*l*. respectively.—*Mr. Dent's Lectures on Time-pieces, &c.*

"* The principle of these bow-springs will be immediately seen, by conceiving the common archery bow fixed horizontally, with its cord upwards; the body of the carriage being attached to the cord, sways both perpendicularly and sideways with perfect freedom.

"† Great diversity of opinion exists respecting the cause of elasticity in springs: by some it is referred to different states of electricity; by others the elasticity is considered to reside in the thin, blue, oxidized surface, the removal of which is thought to destroy its efficacy, much in the same manner that the elasticity of a cane is greatly lost by stripping off its siliceous rind. The elasticity of a thick spring is certainly much impaired by grinding off a small quantity of its exterior metal, which is harder than the inner portion; and perhaps the thin springs sustain, in the polishing, a proportional loss, which is to them equally fatal.

"Mr. Dent stated a the British Association, 1841, that he found, experimentally, that the bare removal of the blue tint from a pendulum spring, by its immersion in weak acid, caused the chronometer to lose nearly one minute each hour; a second and equal immersion scarcely caused any further loss. He also stated it as a well-known fact, that such springs get stronger, in a minute degree, during the first two or three years they are in use, from some atmospheric change; when the springs are coated with gold by the electrotype process, no such change is observable, and the covering may be so thin as not to compensate for the loss of the blue oxidized surface."

MR. WEALE'S ENSAMPLES OF RAILWAY MAKING.*

For spirit and liberality, as a publisher of works on engineering, architecture, and other cognate subjects, Mr. Weale stands nearly unrivalled; and we sincerely hope that, as his labours in that capacity have been great, so also has been his reward. On the present occasion he makes his appearance before us in a new capacity, or rather triplicate of capacities, partly old, and partly new; first, as the author of some Preliminary Observations of his own, on railways; second, as the editor of certain other men's contributions on the same subject; and, third, as the publisher of the whole. We are sorry we cannot compliment him on the result of this somewhat ambitious effort. The book, so far as externals go, is, like all Mr. Weale's books, very handsomely got up; but its value in all other respects is rather in the inverse proportion.

The theme of Mr. Weale's Preliminary Observations is, the great expense of English railways, compared with those of continental Europe and America. The average cost of our railways is stated to have been about 30,000*l.*; of the Belgian, 15,000*l.*; of the Prussian, 9,000*l.*; the American, 4,000*l.* A thorough investigation of the causes of these remarkable differences would have been interesting and useful; but that with which Mr. Weale has favoured us is superficial and scanty in the extreme. A miscellany of facts, selected without care or discrimination from those most familiar to the railway public, and thrown most loosely together; some random assumptions about the immateriality of steep gradients, and the perfect sufficiency of timber bridges and viaducts; and a few such sage and novel suggestions as "a strict regard to economy," "the adoption of legislative enactments to curtail the expenditure, in all its ramifications," and the selection of such persons only for "chairmen, vice-chairmen, and directors," as "are willing to discharge *gratuitously* the duties" of their respective offices, make up the sum and substance of Mr. Weale's treatise. Of the ability of the worthy bibliopole to pass an opinion on any of the many grave and important questions involved in his inquiry, the following may serve as a sample—or, as Mr. Weale would, perhaps, more *unaffectedly* say—"*ensample.*"

"It is not a little remarkable, in speaking of the difficulties which have been overcome in this branch of engineering, that the first instance of an exploratory survey of land, of the character of Chat Moss, should have occurred at that place, and that it should, up to this day, have remained unknown to the profession; that it was first crossed by the original projector of the railway, Mr. William James, who, from the practical impossibility of otherwise surveying it, owing to the extremely soft nature of the soil, *was obliged to lay flat on its surface, his entire length, and, rolling over and over*, thus explored that portion of the line known as Chat Moss. In this dangerous and novel enterprise he was followed by Mr. *Robert* Stephenson, who, adopting of necessity the only means which offered itself of accompanying the ingenious and enterprising projector of the railway, actually followed Mr. James's expedient, and thus had the satisfaction, at the outset of his professional life, of encountering an extraordinary difficulty, and of enjoying, in the issue of the enterprise, his share in one of the greatest triumphs of engineering art."—Page iv.

That Mr. Weale should swallow so ridiculous a story as this, and seriously expect others to swallow it too, shows a degree of gullibility very inconsistent with the office of a public censor. No wonder this new method of surveying should, "to this day," have remained "unknown to the profession," since, of a certainty, it was but the other day invented by some of the wicked wags who frequent the "sanctum" of the "Architectural Library, High Holborn," and are in the habit of testifying their gratitude for the kindness of its proprietor by playing on his credulity. Mr. Weale may never have seen the late Mr. James; and if so, it is the less surprising that he should have missed detecting the hit at his obesity which lurks under the idle jest, and constitutes, perhaps, in the mind of its author, the

* Ensamples in Railway Making; which, although not of English Practice, are submitted, with Practical Illustrations, to the Civil Engineer and the British and Irish Public. By John Weale. 208 pp. large 8vo., with numerous plates. 1843

cream of it; but, familiar as he is, or ought to be, with the history of our engineers, it is not so excusable that he should suppose Mr. *Robert* Stephenson to have been exploring Chat Moss by the new method of measuring his length upon it, at a time when he was quietly pursuing his studies at college. The most inexcusable thing of all, however, is, the gulping down so readily a piece of imposture altogether so gross and palpable.

The contributions to which Mr. Weale has but fulfilled the office of editor are, a description of the works on the Utica and Syracuse railroad, (United States,) by Mr. R. F. Isherwood, C.E., of New York; and an account of the Belgian railways, by Mr. E. Dobson. The substance of the first has already appeared in the *Franklin*, and other American journals, which, we are happy to say, are no strangers in this country; and the latter is but a translation of official documents, which the liberality of the Belgian government had already put into the hands of every English engineer who chose to apply for them. The former, however, is here illustrated by a great number of engravings, which we have met with no where else, and which must be indispensable to any engineer desirous of adopting, in whole, or in part, the economical plan of construction for which the Utica and Syracuse railway is remarkable, (but as contrasted with European railways only;) and the latter is a very good translation, for which not a few of our English engineers will be very glad to exchange their French originals.

We have no intention of going any deeper than Mr. Weale has done, (which is scarcely skin-deep,) into the causes of the greater cheapness of foreign railways, as compared with our own; but we cannot help noting down as we pass, some striking facts in relation to this point, which go to show that, whatever these causes may be, the difference *quoad* revenue is rather in favour of the dearer lines. The Belgian railways, though costing only 15,000*l*. a mile, have never yet realized more than 3 per cent.; and the American, though costing but 4,000*l*., are nearly all in a state of actual or approaching insolvency; while the average returns of the English railways, on their enormous average expenditure of 30,000*l*. a mile, is close on 5 per cent. Cheapness and dearness are terms which in no two countries have the same meaning; that which would be cheap under one set of circumstances, may be intolerably dear under another. Every thing depends on what the pocket result is in the end. Neither the Belgian shareholder, who but receives his two and a half per cent., nor the American, who is paid next to nothing, in a paper currency good for nothing, can have much to pride himself upon, in comparison with the English shareholder, who, though he may have invested ten times as much capital as they have, is paid five pounds in sterling coin, per annum, for every hundred he has invested, and the more he has invested, is only so much more a gainer.

Let it not be supposed that we are therefore disposed to justify the extravagant expenditure which has, beyond all question, distinguished many of our English lines of railway. All that we mean to say is, that, while pondering on the one hand, the greater cheapness of foreign railways, we must not overlook, on the other, the greater productiveness of our own; and that, if we wish to strike a just mean between them, we must take all the circumstances of both into account. All "ensamples" are not models; and of "ensamples" there be both good and bad. We would class Mr. Weale's "ensamples" among the good; but there are, nevertheless, many things in them which are of no application whatever to a country like this, and some which, in any country, had better be avoided than imitated.

THE EAST LONDON WATER-WORKS ENGINES.

The East London Water-works are remarkable for having been the first, in this part of the country, where an engine on the Cornish system was erected; and the engineer of these works, Mr. Wicksteed, is remarkable among engineers for the independence of judgment which induced him to

depart so far from beaten paths; and for the zeal and ability with which he has since upheld, through various channels, the superiority of the Cornish engine. His valuable work "On the Cornish and Boulton and Watt Pumping-engines," we noticed at the time of its appearance, (see *Mech. Mag.*, vol. xxxv., p. 427.) He has now published, by way of supplement to that work, a set of plates, eight in number, of the engines erected at the East London Water-works—both those on the Boulton and Watt plan, and those on the Cornish.* The plates are by Gladwin, and, in point of size (30 in. by 22) and beauty of execution, superior to any thing in the way of mechanical engraving which we remember to have seen—with the exception, perhaps, of Milne's, of Edinburgh, engravings of the Craighall Colliery engines, (see *Mech. Mag.*, vol. xvii., p. 321.) They are accompanied by a letter-press "Explanation," which Mr. Wicksteed states he has been obliged to entrust to a friend to do for him, being himself "too much occupied to afford the necessary time for that purpose." This is to be regretted, for the "Explanation" is not worthy of the engravings; being a very meagre and marrowless affair, in the inventory or catalogue style, and never once rising to the dignity of philosophical analysis. Something in the way of comparison between the two sorts of engine was naturally to be expected; but this has not even been attempted. Had such a comparison been gone into, the writer would, of course, have considered it only fair to state, that the Cornish engine at the East London Works s after the newest and best Cornish fashion, while the Boulton and Watt are old engines, and much inferior, in many respects, to the more recent productions of the Soho school.

* Illustrative Plates of the Cornish and Boulton and Watt Engines erected at the East London Water-works. By Thomas Wicksteed, C.E. With Explanation of the Plates. Weale, London.

"Z.'s" THEORY OF PHOTIC FLUIDS, AND THE UNDULATORY THEORY OF LIGHT.

Sir,—Your interesting Journal of to-day contains, from your correspondent "Cogito," a comment on my letter to you of 31st ult. He endeavours to identify my propositions concerning the constitution of ponderable matter and imponderable photic and ethereal fluids with some obsolete theory of "Antagonist Essences," and concludes in consequence that I proceed upon an untenable principle, while he evades the main questions put at issue by me. I therefore beg your leave to go into a brief analysis of his evasive argumentation.

Without defining what the "Principle of the Antagonist Essences" was, or purported to be, so as to prove their identity with the principle or principles of my propositions, "Cogito" asserts, that we are not acquainted with *such* "Essences." Probably no more than I am with *his* meaning. If by *such* "Essences," he means *invisible* and *impalpable*, as well as imponderable material powers, I agree with him, that they are chimerical: but that is *not my* principle; for I treat of such *imponderable*, yet material fluids as are both *visible* and *palpable*, though imponderable, and I endeavour to establish, *how many* there are, *where*, and in *what* disguise they are to be found, and it only remains for me to show systematically, *how* and by *what laws* they are passively and actively present in ponderable matter, so as, in combination therewith, to produce the periodical elemental metamorphoses, or continually regenerated natural phenomena, which comprise all compound bodies, whether *organic* or *inorganic;* and in doing so, by and by, I intend to support every trace of them by the known *facts* and effects of which the scientific researches hitherto made have already hoarded up such a rich stock, that keeps daily increasing. Again, if by "Essences," spiritually intellectual powers, wielded by souls, be meant, I answer, that I consider them to be moral realities, forming a system *per se*, and quite distinct from the "*ethereal and photic fluids*," the latter being mere subservient organs of the former; and subservient to them within the *limits* of the laws of nature; the *unlimited* use of both orders, namely, of spiritual and material powers being the prerogative of the omniscient and omnipotent Creator, who is thereby superior to, and Lord of, every creature and thing.

In my first letter, I could not and did not make use of the word *essence*, because it is too undefined and general a term, its meaning in common parlance being rather that of an *extract* of some inherent property belonging to, and hidden in matter, while I only deal in obviously palpable material powers, which being distinct, and either inseparably fixed, or only transiently and alternately present, qualify the properties and mediate the metamorphoses of ponderable matter.

Neither have I made use of the word "antagonist," because it also implies opposition arising from ill will or malice, while matter, whether inert or active, ponderable or imponderable, has neither intellect nor will, and merely exists to obey the *moral impetus* of an *intellectual* Lawgiver. But I have adopted the terms "positive," and "negative," which pervade all scientific theorems, chiefly in reference to the acknowledged *polarity* of some well known imponderables. I do not content myself, however, with using the said terms only for denoting *polarity;* I take a wider range. I apply the term "positive" to such of the photic fluids as I have recognised, when active, to tend or move centrifugally, say, by radiation *from* a centre, with a spontaneous diffusion, enlarging, or expanding the ether and the ponderable atoms containing ether, at the same time causing atomic volatility, or vibration and undulation; and I apply the term "negative," to such photic fluids as I have recognised, when active, to tend or move centripetally, or with inverse radiation *towards* a centre, their prior forced expansion, reacting thus, and tending to counteract the positive fluids, so as to recontract the expanded ether and ponderable atoms to a certain degree of condensation and stagnation; and to restore the state of elemental inertia and central congeration. In my humble opinion, it is on the negative powers, counterbalancing or over-balancing (as the case may be) the positive, that the laws of gravitation, cohesion and attraction, mainly depend. By dint of positive, yet inanimate power, wielded by the intellectual impetus of a man's will, a stone may be lifted and thrown by him at a distant object, the intellect knowing by experience, that the gravitation of the stone will act after the positive power used in lifting and directing it is spent, and he accordingly, in aiming, pre-calculates the measure of both, from judicious experiments made *à priori*

It is a *Newtonian* principle, by the theory of emanation, to assume the existence, radiation and refraction of photic matter. Photography proves it to be fact and truth; and when I say, that vibration and undulation with atomic friction and central ethereal expansion, accompanied by radiation of visible light from its intense accumulation in gaseous fire, is the consequence of such an accumulation of positive photic fluids, I do so on a weighty radical authority, and oppose a theory, which I think confounds the *consequence* with the *cause*. The sphere of every flame diffusing *brightness* is encompassed by a predominance of *darkness*, or the *negative* photic fluid, which is capable both to absorb and repel the radiating *positive* fluid, thus confining it to a limit, and extinguishing it as it spends power in diffusion; any surplus thus diffused, is re-attracted by the galvanic currents, which keep up a photic communication between the earth, the sun, and the other orbs.

By ascribing the property of fluidity to photic matter, I did not mean to assimilate it to the liquid water, nor even to air, and I think "Cogito's" water parable about wetness and dryness quite out of place. Oxygen is a perfectly *dry* gas, yet it is a constituent of water, in which its gaseous atoms are condensed to a 2000th part of their gaseous volume, and combined with equally condensed hydrogen, from which it seems to derive its watery property in combining with it. Now air, which likewise contains oxygen, by the law of nature, can yet combine but with a very small proportion of water, and expels every surplus of water which may accumulate on a stone causing wetness on it. What is not absorbed by the stone, or cannot run off from it, is gradually vaporised by the air, and unites with clouds in colder upper strata of the atmosphere, while the stone at last becomes dry. "Cogito's" application of this phenomenon does not, however, hold good, for wetness and dryness are not matters, but merely denote the superficial condition of bodies acted upon by other wet or dry matter; when the *water disappears* from the stone, *something else* takes up its place: that *something* is the opponent dry fluid of air, which removes the water by *pressure* and vaporisation; therefore, there are *two* opponent elements concerned in the case, combatting for space by law. Now the same law holds good with reference to darkness and light, which merely combat each other for space, because they are *two* distinct opponent fluids, alternately or jointly filling space conjointly with other matter. When they do so, pervading transparent liquids and gases, *they are visible;* but in opaque bodies they are invisible, and positive light is yet latent in most of them to such a degree that friction will rouse and call it forth, while they always radiate darkness, and also attract it readily. The difference is only this, that water can absorb but *very little* air, and air but *very little* water; whereas, darkness can absorb a great deal of brightness, after mixing with it in shades, until surplus brightness retires. An absolute purity of either does not exist in our atmosphere, which is a compound photicated gas; nor could our eye bear a stream of *pure* positive light, the intensity of which would greatly exceed even the dazzling of the chemically and negatively tempered sunbeams, which already are *so* dazzling that a human eye cannot bear to look straight and stedfastly into the sun's face.

Dr. Moser asserts that there is *latent light* as well as latent heat, and I agree with him, thinking it, at the same time, obvious, that the *negative* fluids are as capable to be latently hidden as the positive; consequently, that if there be latent light and heat, there also is latent darkness and cold; nay, I go further, and say, that the latter two exist and predominate every where, where there is no burning flame or a galvanic current in refraction diffusing abundant brightness: that the accumulation of intense masses of positive light (in combination with a neutralised proportion of the negative,) is confined to the spherical halos of the sun and fixed stars, and to semispherical halos in the planetary atmospheres and lunar halos, while the flaming combustion of matter on planetary surfaces is comparatively a mere trifle, chiefly caused by artificial ignition, for supplying us with light when darkness prevails.

Our intellect is not, as "Cogito" seems to hint, confined to the notion of "spreading darkness;" it owns also that of "*brightness* spreading"—in darkness; and this is one of the few cases, in which the *appearance* is at the same time a well founded reality,—"least understood."

With regard to atomic vibration, "Cogito" has misunderstood me entirely, and I humbly request him to reperuse my letter, in which I have *not* said, that atomic vibration is the *radical cause* of all elemental change, nor have I drawn *his* conclusions therefrom; on the contrary, I combat the very idea of it, as being the erroneous principle of the theory of undulation. After having stated, that vibration was caused by the active predominance of positive photic fluids in consequence thereof, I pronounced slow vibration at a low temperature to be slow combustion incessantly going on in nature. I have further said, that the seat of the cause is in the hollow centres of elemental atoms, holding ether fraught with photic fluids, and that this is the shape in which heat is conductible. This is the *main new* and important point at issue for solving a most important question; "Cogito" evades it totally in his comment, as well as the next *new* proposition, namely, that the ponderable elements consist of inert radicals chemically combined with fixedly condensed photic fluids, contaminated with terrestrial effluvia. All this is, in my opinion, evidently bespoken by the properties and affinities of the said elements, and I hope to prove that such is, and of necessity must be, their constitution. As I had *not* set forth what "Cogito" pleases to ascribe to me under the name of "antagonist essences," so have I merely adopted the scientific distinction of positive and negative powers. I have nothing to retract or unsay; on the contrary, when I come to publish my system of *causes* with their consequences, I hope and trust to establish my propositions by careful analysis of the effects with which we have become acquainted by a series of the most valuable and elaborate researches and experiments already on record. In the meanwhile, I request forbearance from "Cogito," and others differing from me in opinion; they will ultimately find, that I shall not call upon them to believe or receive what I cannot prove by reference to good experimental authority, with the greatest readiness to admit substantial objections.

May I, in conclusion, request the favour of you, Mr. Editor, to convey this explanation to "Cogito," and your other readers, by insertion in your Journal; thus completing the obligation you conferred upon me by doing so with my first occasional letter.

I am, Sir, your obedient servant,

Z.

London, January 14, 1843.

PHOTIC FLUIDS.

Sir,—A letter in the 1013th Number of your valuable Magazine, requires a few remarks from me, as it touches closely on the "New Theory of the Universe," which I some time ago proposed through the medium of your pages, under the signature "E. A. M."

That which I have called firmamental fluid, is the "or" (אור) of the Hebrew text, it is translated light, and *is* light; but light, TO BE VISIBLE, *must be in motion, and that motion directed towards the organ of sight*. Hence the *necessity* of sight *givers*. The *adamantine* atoms which saturate the firmamental fluid ("or") are not, and cannot become porous individually. They may, probably, in part, in the living body be separated from the "or," so as to allow the latter to circulate purely; thus affording to the organized body a material which is not to be obtained pure elsewhere in nature. Putrefaction is the resumption of the individual atoms by the "or:" in other words, the dissolution of organic life. This resumption assumes the globular form, and, under this form, becomes photic fluid, or the conveyer of *visible* light.

That photic fluids receive and retain (for a time) the *form* of the colours on which they strike, is evident to our sight, in the transmission of light through coloured glass; the colour being carried on to another object.

That photic fluids, when relieved from the predominating influence of those of the sun

should act with more force, seems a very simple conclusion, (although that force may not be sufficient to cause the sensation of *visible* light,) and hence the effects of their power, if impressed under favourable circumstances, may continue. The medium of space, of course, consists of firmamental fluid, ("or,") individual atoms, and photic fluid; their changes in conjunction with organized matter completing the self-igniting wheel of nature according to the law of the Almighty.

The photic fluid may be regarded as the base of all other traversing fluids, enabling many of them to take the stamp of that on which they strike; as, for example, *perfume, flavour, sound, touch;* while on their activity depends the sensation of *heat* in accordance with their quantity.

The adamantine atoms may be regarded as a sand at par with the "or." That the ancients had some idea of the kind is evident in their expression of "the sable firmament." The brilliant diamond is the emblem of the sorrow for lost friends, while an ultimate atom may be regarded as the unbreakable adam*ant*. Would it be going too far to say, that it agreed with its name? Be all this as it may, it certainly agrees with the holy text, which employs a word for the firmament which expresses a matter reduced; as a miner reduces his material.

You would do me a great favour by giving the above an early place in your pages.

Your obedient and obliged,

EMILY ANNE SHULDHAM.

Norton Fitzwarren, Jan. 16, 1843.

MR. LUCY'S ENGINE.

Sir,—When a writer declines to continue a discussion which originated with himself, in your pages, he should not indulge in observations of such a nature as call for a reply.

In the writings of an eminent ancient author there is to be found the demonstration of a problem in physics, not inapplicable to the present occasion. It is a logical demonstration to prove the existence of a vacuum, extracted from the fourth book, chap. vi., of Aristotle's "Physics."

"If there be no vacuum, there can be no locomotion; for a space already full cannot receive any thing into it: if it did, there would be two bodies in the same place, which is an absurdity."

Some commentators have it—

"The assumption is thus proved, because a body that changes its place is received into a space full of matter, or into one that is empty: if into an empty space, the point is proved; if into a full space, then two bodies must penetrate one another's dimensions."

It may be asked, What has Aristotle, or this problem, to do with Mr. Lucy's mill? It has this to do with the discussion, that it affords an excellent specimen of that manner of reasoning which we are called on not to attempt to disprove by mechanical demonstration, because that would be to discard and set aside reason! There was a time when such reasoning was considered conclusive and unanswerable; and, from the course taken by your correspondent, it may be doubted whether the time is yet wholly past. Need we wonder that true science should have been so much impeded, when ideas of such a nature could pass current?

A very simple experiment may suffice to show the sophistry of the above argument, and to convince any one of the necessity of trusting, in physical matters, more to experiment than logic. Put a leaden bullet into a bottle quite full of water, and cork it well down. We have here as good a plenum as need be desired, and we shall find the motion of the bullet not to be much impeded by the water. Does the bullet, now, in this case, move into a full space, or into one that is empty? Why, truly, it may be said, into neither; it only exchanges place with the water, and neither the demonstration, nor the refutation of that demonstration, proves or disproves the fact of a vacuum, but leaves the problem where it found it, without a solution. It was an observation of Lord Bacon, that every natural disquisition is brought to its proper issue, when a physical principle terminates in a mathematical operation; but your correspondent wishes to reverse this doctrine, and will turn the world upside down, to make physical facts square with his mathematical conclusions.

If the opinion extracted from Mr. Russell's publication be sound, namely, that the great fundamental principle in the construction of machinery is, that "the work done depends, in quantity, only upon the quantity and velocity of the power applied, and not at all upon the form of the machine," your correspondent must perceive that no alteration in Mr. Lucy's fly-wheel could make any variation in the quantity of work done; and that a fly-wheel weighing one ton, or one hundred, should be equally effective as the one weighing twenty-four tons. But is your correspondent disposed to go that length with the principle?

I cannot conceive how the doctrine, that a deficiency of effect, or a loss of power in the crank and fly-wheel of engines, can be in any way inconsistent with the established laws relating to the motion of bodies, considered apart and free from friction; on the

contrary, I think them perfectly consistent therewith.

Your correspondent thinks I am in doubt whether such a thing as the loss in question takes place. I can assure him I never was in doubt about it; but I was struck with the novel manner in which your correspondent, "M." undertook to demonstrate, mechanically, the fact, and in such a manner as I still consider unanswerable.

Your correspondent assumes and takes for granted the very point in dispute, that there was no power lost by the old fly-wheel. Aristotle, in the argument above mentioned, should have introduced another alternative; but your correspondent makes use of one that is inadmissible.

I am, Sir, &c.,
A LOOKER-ON.

NOTES AND NOTICES.

Atlantic and Pacific Junction Canal.—From a paper by Humboldt read before the French Academy of Science, it appears that the labours for cutting a canal across the isthmus of Panama are advancing rapidly. The commission appointed by the Government of New Granada for the construction of a canal to unite the two oceans, has terminated its examination of the localities, and has arrived at a result as fortunate as it was unexpected. The chain of the Cordilleras does not extend, as was supposed, across the isthmus, and on the contrary, a valley very favourable to the operation has been discovered. The natural position of the waters is also favourable. Three rivers, over which an easy control may be established, and which may be made partially navigable, would be connected with the canal. The excavations necessary would not extend to 12½ miles in length. The fall may be regulated by four double locks, 138 feet in length; and the total length of the canal will be 49 miles, with a width of 135 feet at the surface, and 55 feet at the base; the depth will be 20 feet. The canal thus executed will be navigable by vessels of from 1000 to 1400 tons. According to the estimate of M. Murel, a French engineer, the total cost of this canal would be only 14,000,000 of francs, including the purchase of two steamers.

Quick Firing.—A mechanic at Rudkyoping, (Denmark,) by name Rasmusseu, has invented a musket from which thirty discharges per minute may be made with ease. The experiments which have been instituted show that it strikes an object at eighty paces distance, with the greatest accuracy. The rapidity of the discharge may be considerably increased; in fact, on one occasion, the musket was worked at sixteen shots in twenty seconds.—*United Service Magazine.*

Extraordinary Mechanical Invention.—A gentleman residing at Milton next Gravesend, a native of Faversham, who for many years carried on an extensive business at Ramsgate, after eleven years' study, has succeeded in completing some machinery, which will, when brought into use, he imagines, supersede the use of steam power. It may, he thinks, be applied to clocks of any description, require no winding up when put together, and will continue going so long as the materials last.—*Correspondent of the Times.*—The writer of this announcement might quite consistently have added at the end of it, "and for some time after."

Virgin Gold.—A paper was read last week at the Royal Academy of Sciences, Paris, on the recent discovery of a mass of native gold, weighing 36 kilogrammes (about 80 English pounds), on the eastern side of the Ural. This enormous mass, which is double the size of any hitherto discovered, was found at a few feet beneath the surface, under singular circumstances. The establishment formed at this part of the Ural for the purpose of seeking for gold had tried every part of the ground near it, and the speculation being deemed a hopeless one it was abandoned, and the buildings which had been erected were demolished. It was precisely in the ground on which one of these buildings had stood that this mass of gold was found. M. Von Humboldt, who made the communication to the Academy, added some interesting facts relative to gold-mining industry in Russia. It appears, such is the prodigious increase of washed gold in Russia, and especially in Siberia, to the east of the southern chain of the Ural, that the total produce in the year 1842 amounted to 16,000 kilogrammes, of which Siberia alone furnished 7,800 kilogrammes. This is the produce to the Russian Government, but we have reason to believe that the real amount of produce is larger, and that five per cent. in value is secreted by the agents who are employed to superintend the operations.—*Galignani's Messenger.*

Night Telegraphs.—M. Louzoni, an Italian, has invented a system of night telegraphs, consisting of three fixed luminous points, which may be eclipsed together or separately. These three points are disposed of at the extremities of a right-angled triangle, having two equal sides, one horizontal, the other vertical. If, by means of a screen, one of these lights be hidden, the other two indicate the direction of the side opposed to the eclipsed angle, and there will be thus three different signs. The three points shining simultaneously will form a fourth, and a fifth is given by a single light. By combining two by two, the numbers corresponding to each of these signs, M. Louzoni designates the different letters of the alphabet.

"Man-overboard" Boat.—The experiments made yesterday with what is called the "Man-overboard" Boat succeeded beyond expectation. She was first hoisted endwise to the yard-arm of the ship *Panama*, 35 feet from the water, then suddenly cut loose; she plunged but two feet, keeping right side up, and the water running out of the scuttles in the bottom. She was next hoisted 45 feet, and again cut loose to a similar effect. She was then hoisted to the great height of 52 feet, where she hung ready for a dive that would have completely destroyed a boat of any other construction; the signal, "man overboard" given, she plunged from her aërial elevation, dipping the end of her bow two feet six inches in the water, and bounding to the surface in an instant. She was next thrown over the bulwarks of the ship (21 feet from the water) as if some one had really fallen overboard. A man then stood on her side long enough to swamp any three ordinary boats, and endeavoured to press it under water, but in vain. During these experiments her bottom was open, having two holes cut in it, each 10 inches square. She is built on the plan or Francis' life boats, and it is impossible for any boat not possessing their improvements and perfections to perform such feats. In the event of a man falling overboard they may be thrown over the side of the ship, and the man be seated safely on the water in a few seconds.—*New York Courier.*

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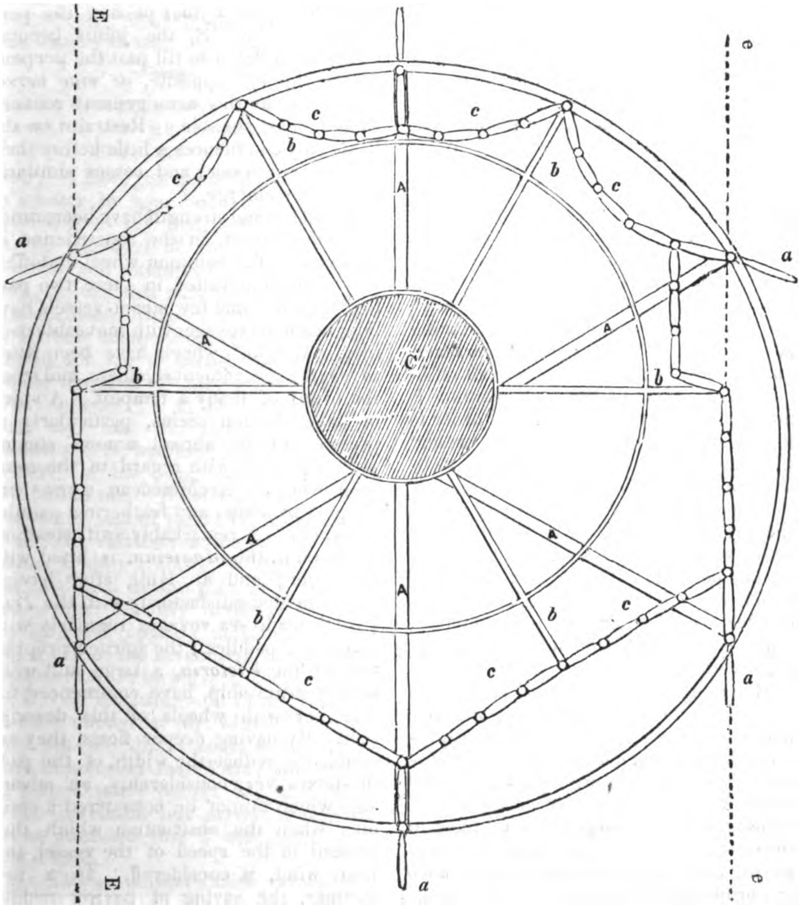
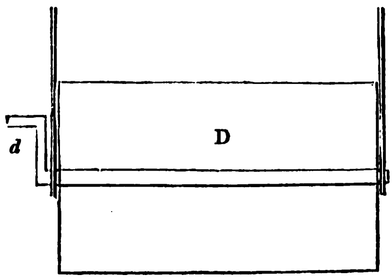
WAKE'S PATENT PADDLE-WHEEL.





WAKE'S PATENT PADDLE-WHEEL.

Sir,—I beg to hand you a plan and explanation of my paddle-wheel, which I shall be obliged if you will insert in the *Mechanics' Magazine*. Considering that so many patents for improvements in propelling apparatus have been taken out, another patentee may expect to be looked upon with as much suspicion as a starting adventurer in the literary world. That the common wheel cannot be improved upon, may be stoutly maintained, and a hundred failures referred to as proof. The strength of this evidence certainly cannot be denied: patentees, undoubtedly, one after another, have been disappointed, and involved in serious loss. It must, nevertheless, be allowed, that these continual efforts, unsuccessful though they may have been, prove the wide-spread opinion, that something *is* to be gained. And perhaps *perseverance* may at last solve the problem satisfactorily. At all events, perseverance is not a dishonourable quality. In order to its existence, difficulties must present themselves, and they do not appear to be wanting in paddle-wheel improvement.

The object of the wheel represented in the prefixed engraving is, to direct the floats, while under water, into a perpendicular position. The eccentric motion, which has long been known as a means of effecting this purpose, is introduced; that which is new is the mode of connecting it with the floats.

Referring to the plan, fig. 1, A A are the arms of the common wheel; the axle is hid from view; the outer circle represents the rim. *a a a* are the floats, turning on pivots which are inserted into the arms A A; B is the eccentric wheel, turning on an enlarged axis C, fixed to the vessel's side as is customary. The projecting arms of the eccentric wheel *b b b* are ordinarily connected with the floats by rods having a pivot at each extremity; but, in the present wheel, a series of joints, *c c c*, are used instead, two of which are required to each float. D, fig. 2, is a float, (which is made much deeper than ordinary, that the width of the paddle-wheel may be reduced,) one pivot of which, *d*, is lengthened and bent upwards, and again to the left: to this part the series of joints are connected. As the eccentric works next to the vessel, this pivot, of course, must be the inner one. The substitution of joints for the bar having a pivot at each extremity, commonly used, has the following effect. During the greater part of the revolution of the paddle-wheel they are slackened. Immediately on a *float* passing the perpendicular line E, the joints become tight, and remain so till past the perpendicular line e,* opposite, or *vice versa.* Friction is by this arrangement reduced as much as possible. Restraint on the floats only commences a little before their entering the water, and ceases similarly when they emerge.

Simplicity and strength have been aimed at, to the utmost, in the construction of this wheel. The common wheel undoubtedly stands unrivalled in these two particulars, but some few steam-vessels have long made sea voyages with moveable paddles. Morgan's wheels have been fitted to several government steamers, and stood the brunt of many a tempest. A spirit of dissatisfaction seems, particularly at present, to be abroad among steam-packet owners, with regard to the common wheel. Archimedean screws are adopted by some, and feathering paddles by others. A remarkably swift steamer, lately built, the *Magician*, is fitted with the latter; and at Hull, after having experimented satisfactorily with the *Iris*, (which made sea voyages regularly with feathering paddles,) the spirited proprietors of the *Victoria*, a large and well-known steam-ship, have commenced fitting her with wheels of this description. By having deeper floats, they are enabled to reduce the width of the paddle-boxes very considerably, an advantage which cannot be considered a small one, when the obstruction which they present to the speed of the vessel, in a head wind, is considered. In a new steamer, the saving of having paddle-wheels about half the width of the common wheels would be very considerable. Those who are about building new steamers should have their attention directed to this particular. The advantages which the different angle at which feathering

* These lines, E e, are drawn so as to bound the circle described by the projecting arms of the eccentric wheel. In planning a wheel, the height, therefore, of the water line must be determined before the length of the projecting arms of the eccentric is fixed upon.

paddles enter and leave the water occasion, especially in rough weather, might be referred to; but that is a subject with which those who have studied paddle-wheels are familiar. Trusting I have not encroached too much on your limits,

I am, Sir, your obedient servant,

JAMES WAKE, Jun.

Goole, January 12, 1843.

DREDGE'S SUSPENSION-BRIDGE SYSTEM —REPLY OF MR. DREDGE TO PROFESSOR MOSELEY.

Sir,—I have just seen Professor Moseley's letter in your last Number, and in reply beg to say that, since writing to you on the 31st of December, I have obtained and examined the Professor's work, at least that part of it which treats on suspension-bridges; and, having done so, I freely acknowledge that there is no ground for me to accuse him of "borrowing the ideas of another, without acknowledgment." At the same time I must say, that the misunderstanding, whatever it is, has arisen entirely from an error of his own, made in the work now before me. What I allude to is the note at the foot of page 543, in which he says, "the variation of the section of the chains, as shown above, is the same as that exhibited in the plan of a suspension-bridge recently invented by Mr. Dredge, and appears to constitute the only merit of the invention." Supposing this assertion to be correct, and comparing it with the paragraph in the Preface, which is quoted in Mr. Moseley's letter, I do not see that I could arrive at any other conclusion than I did; and knowing that no other person had any claim to the invention but myself, I think it will be admitted that I was justified in what I said.

Mr. Davies Gilbert's table, which Mr. Moseley alludes to, is very well known; and I had always entertained an idea that the variation in the section of the catenary was approximated much nearer than it could be carried out in practice, and could not think that Mr. Moseley would have wished to extend the investigation further; but I was more surprised to find that, after he had done so, he had confounded my principles of suspension with it, when, if he had examined any bridge I have erected, or any papers I have published, he must have seen his error. Take, for instance, the foot-bridge across the ornamental water in the Regent's-park, which is 150 feet span. The section of iron in the chains, at the points of suspension, is 8·904 inches, and at the centre ·742 inches, exhibiting a difference of 8·162 inches.

If it were upon the principles of the common catenary, with vertical rods to sustain the platform, and the section of the chains the same at the points of suspension, namely, 8·904 inches, the sectional area of the chains at the centre, according to Davies Gilbert's table, must be 8·60 inches, being a difference of only ·304, instead of 8·162 inches; and, besides this, it would be less powerful. From experience I can state, that, as near as it can be approached in practice, I have found my suspension-chain so to vary in its dimensions, as to be every where of the same strength.

Let Mr. Moseley's opinion upon this point, however, be what it may, I must request of him, in any subsequent edition of his work, to suppress the note in question: and this for two reasons—first, because it is incorrect, and therefore prejudicial to his work; and, secondly, because it may be prejudicial to me.

I trust that this explanation will satisfy Mr. Moseley, and clear me from all imputation of having accused him unjustly; and allow me to add, that, if what I said was founded in error, it was in consequence of the error committed by him in his own work.

I am, Sir, your obedient servant,

JAMES DREDGE.

Bath, January 19, 1843.

[We shall be glad to receive the papers mentioned by Mr. Dredge in his postscript.—Ed. M. M.]

DISSOLVING VIEWS.

Sir,—The dissolving views exhibited at the Royal Adelaide Gallery and the Polytechnic Institution, having excited considerable attention, and, so far as I am aware, nothing explanatory of the means by which the effects are produced having been published, I am induced to offer a few remarks on the subject, for insertion in your valuable Journal.

Sightseers may be divided into two classes, the ignorant and the enlightened. The former class are great lovers of the marvellous, and are delighted with any effect which seems to them to partake of this character. But if they are made to

comprehend—sometimes no easy task—that the effect with which they are delighted, is produced by simple and natural means, with other and less surprising effects of which they may or may not have been previously familiar, their feeling of delight is changed into one of disappointment, approaching often to indignation, at what they are pleased to consider a deception which has been practised upon them. It is not for this class that I write, few of whom, however, I imagine, are readers of the *Mechanics' Magazine.* My remarks are intended for the other class, the enlightened—those who, possessing a greater or less degree of acquaintance with the principles of science, think not the more meanly of an effect when they find that it is produced by merely a new application of an old principle.

To come to the point. The dissolving views are produced by the application of the oxy-hydrogen light to a couple of magic lanterns placed side by side. The lanterns are so fixed that their illuminated discs occupy the same place on the screen, and there is a contrivance by which, when the gas is admitted to the one lantern it is withdrawn from the other. If now a view (painted on glass, as usual,) be placed in each lantern, the image of one of them only will be projected on the screen, viz., of the one belonging to the illuminated lantern. But if the light be gradually withdrawn from this, and admitted into the other lantern, it is obvious that the first image will fade, and the other come gradually into view. When the first has completely disappeared from the screen, it is taken out and another inserted, which will be in like manner brought into view, by a reversion of the process.

When additions are made to a view already on the screen, it will be understood that generally the additions are made by the second lantern, while the image produced by the first remains. In this case the portions of the view contributed by each lantern will be of course only half illuminated. But it will be observed that the darkening of the view which is thus rendered necessary, is so managed as to produce the effect of a sudden storm, by the introduction of flashes of lightning, &c.

It is needless to enter farther into the subject, as any one acquainted with the management of the magic lantern, will have no difficulty, from the hints already given, in devising means by which many other equally striking effects may be produced.

Before concluding, I would offer a remark on what are called the *improved* views of the Polytechnic. I give no opinion on the *subjects* of those views; but their *form*, as compared with that of the previous views, I think is the very reverse of an improvement. The previous views were circular, while the "improved" views are larger and *oblong*. The consequence of this is, that, the corners being too far removed from the centre of the field of view, the effects of the chromatic aberration are most disagreeably apparent. Some may like to see the edges of objects invested with those gorgeously coloured fringes which are the effects of this "improvement." As I happen to prefer a picture which resembles nature to one which does not, I must be pardoned if I cannot think with them. I am, Sir, yours respectfully,

G.

Hermes Street, Pentonville, January 21, 1843.

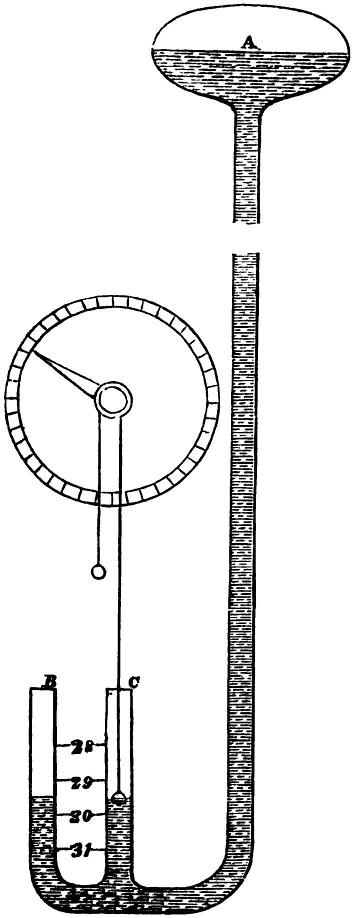
COMPOUND VERTICAL AND WHEEL BAROMETER.

Sir,—The approbation you have expressed of Mr. Readman's patent improvements on the barometer, induces me to invite attention to a form of the instrument which I have nowhere met with, though it possesses some obvious advantages.

The opposite figure represents the form of the barometer, the peculiarity of which, as compared with the syphon and wheel barometer, consists in an ample enlargement of the upper and closed end of the tube, so as to answer the purpose which a cistern serves in the common barometer, of rendering the surface of the mercury, for all practical uses, stationary and unchangeable, and confining the changes in the mercurial column entirely to the lower and open end of the syphon. By this arrangement, with an additional short tube to the syphon, we are enabled to combine in the same instrument the separate advantages of the common vertical and wheel barometers.

1. *Of the common vertical barometer.*—As the surface of the mercury at A remains stationary, we shall have the *full* effect of every variation of the mercurial column in the short tubes B C, which

may be shown on a scale of inches and subordinate divisions, in the usual man-



ner, except, of course, that in this case the scale will be inverted, 31 inches being at the bottom. The surface at A should have ample width, to prevent any perceptible change of level; but if this be inconvenient, and accuracy in the indications of the instrument be desired, it may be obtained by making A bear a certain known proportion to the bores of both the tubes B C—say as 50 to 1—and then reducing each inch on the scale by the amount by which the rise and fall of the mercury in the tubes B C will fall short of an inch. (See the method more fully explained in Dr. Lardner's Treatise on Pneumatics, in the *Cabinet Cyclopedia*, pp. 251, 252.) The intention and advantage of having a separate tube, B, from that which contains the float of the wheel barometer, is, that the surface-line of the mercury will be more easily and correctly determined, not being affected by the presence of any extraneous substance. The tube B should be protected from dust by a cap of thin leather, or other suitable means, which will not interfere with the free pressure of the atmosphere.

2. *Of the wheel barometer.*—In indicating minute changes in the mercurial column, this form of the instrument will have *double* the effect of the common syphon form of the wheel barometer. To perceive this, it is only necessary to recollect that, in the ordinary form of the wheel barometer, the actual rise or fall of the mercury is indicated to only *half* the amount in the short tube of the syphon; thus, a rise or fall of one inch in the whole instrument gives only a rise or fall of *half* an inch in the short leg of the syphon which contains the float. Hence, when the changes in the mercurial column are in themselves minute, and *moreover divided between the two legs of the syphon*, the difference of pressure becomes too slight to move the float, and an early limit is imposed on the indications of the instrument. Now, as in the new form the *full* effect of every change in the mercurial column will be given in the short tube, and correspondingly communicated to the float, it will obviously be capable of indicating changes as minute again as those of the common wheel barometer.

In this instrument the wheel barometer will be best employed in subservience to the vertical scale; the periphery of the wheel should therefore correspond with one inch on that scale, and the dial should be divided into 100 parts, answering to the vernier of the vertical scale.

Having referred to Dr. Lardner's Treatise, I wish to advert shortly to an imperfection he attributes to the wheel barometer, which I am unable to comprehend. He says, (p. 259,) "In this form of the barometer, it is evident that the preponderance of the iron ball (float) assists the atmospheric pressure in sustaining the column. This cause of error, however, may be diminished almost indefinitely, by making the preponderance of the ball over the counterpoise barely sufficient to overcome the friction of the wheel." The meaning of the first part of

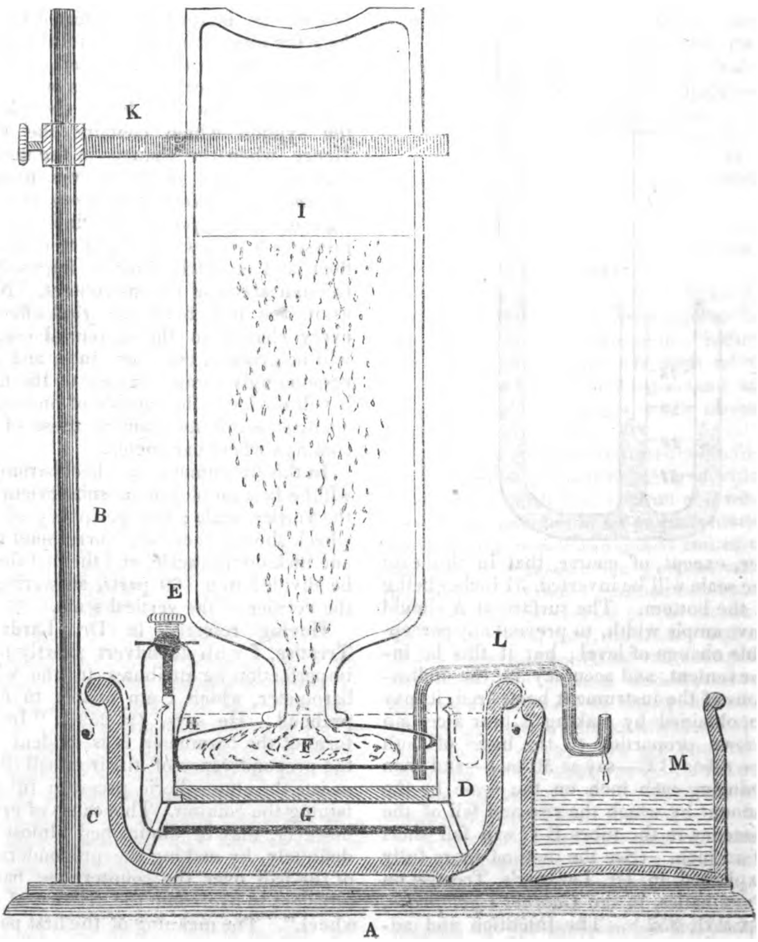
the above extract, as I understand it, is, that the iron ball or float, resting on or partly immersed in the mercury, raises the mercurial column higher than it would stand without it, and makes it indicate a greater pressure than the atmosphere alone would cause. But is not an iron ball, floating—say half immersed—in the mercury just equivalent to so much mercury as is displaced by the immersed portion of the ball? If, then, instead of the ball, *so much* additional mercury were poured into the tube, would it make any difference in the *absolute* height of the mercurial column sustained by the atmosphere? in other words, in the distance between the surfaces of the mercury in the two legs of the syphon? If not, I am unable to perceive that the case is at all altered when the iron ball is floating, half immersed, in the mercury. Does not the ball, *in effect*, become a component part of the mercurial column, instead of exercising an independent pressure on it, conjointly with the atmosphere, as would seem to be the legitimate inference from Dr. Lardner's words? If I have taken an erroneous view of the subject, I shall be happy to be set right.

I am, Sir, &c. &c.,

N. N. L.

January, 1843.

IMPROVED ELECTROTYPE APPARATUS.



Sir,—In experimenting with the electrotype, I have experienced much inconvenience from the want of an apparatus, at once cheap and simple in its construction, and at the same time constant in its operation. The platinized silver batteries of Mr. Smee and others, mentioned in your Magazine, undoubtedly possess all the qualities there ascribed to them; but then they are not only expensive, but difficult to procure by persons situated like myself, far distant from the metropolis; and to make them, requires not only a tolerable acquaintance with chemical science, but also, a number of chemical materials with hard names, enough to discourage a tyro.

The accompanying sketch is a section of an apparatus invented by me with a view to overcome some of the difficulties here enumerated, and I think it will be found to possess advantages in common with no other yet constructed:—

Description.

A is a flat piece of wood, about 12 inches square, with an upright, B, fixed firmly into it. C is a vessel of earthenware; D is a rim of wood, with three legs at the bottom to stand upon, an inch long or thereabouts; this rim has a bottom of plaster of Paris cast in it, about ¼ of an inch thick; E is a binding screw, fixed in the edge of the rim D, through the eye of which the copper wires from the poles of the battery pass, and are firmly held in metallic contact by the screw at top; F is the zink plate, and G the article upon which the copper is to be precipitated. H is a saucer, or any concave article of earthenware or glass, with a hole through the middle about ¾ of an inch diameter; this saucer must be of such size as to go easily into the wood rim D; it rests, concave side down, on three wooden pegs fixed to D, just above the zink plate F; I is a bottle supported by the ring K, and placed with the neck downwards over the hole in the saucer H; L is a syphon made of a piece of glass tube, bent as represented in the drawing, the saucer H having a piece taken out at the side to let it pass through; M is a jar to receive the waste liquor. The dotted curves on each side of D, show the position of a piece of muslin or net about 3 or 4 inches broad, and going all round, one edge of which is fastened by a string tied tight round in the groove at the top edge of D, and the other has a small piece of whalebone sewed in, and made to hang over the side of C, so that between the outside of D, and inside of C, all round, is formed a sort of bag or pouch.

The following is the *modus operandi:*—Put the article to be deposited upon, and the zink plate in their respective places, then fill the vessel C, with a saturated solution of sulphate of copper up to the dotted line, and put a few crystals of the same into the muslin bag to supply the liquid as the copper is extracted. Then fill D up to the same level with one part sulphuric acid and thirty parts water previously mixed; next fill the syphon with the same, and put it in its place; the saucer may now be inverted over the zink and the fountain I, previously filled with the sulphuric acid solution. The hydrogen gas evolved from the zink will collect under the saucer, and be seen to rise into the fountain I, allowing the acidulated water to descend, to supply the place of the exhausted liquor in D, which will flow over through the syphon into M. The fountain I, after a time, will be filled with hydrogen gas, which may be transferred to any convenient recipient till wanted.

It will be seen by the above, that the principal feature of this invention is the application of a fountain to supply fresh liquor to the zink as the other becomes exhausted, so that provision is here made for keeping up the original strength of the sulphuric acid solution, as well as the cupreous one, and at the same time, saving a material hitherto neglected, viz., hydrogen gas, which has become of greater importance since the discovery of the process of autogenous soldering, &c.

If you consider the above worthy a place in your valuable Miscellany, you will confer an obligation on

Your obedient Servant,

WILLIAM WYNN.

Beverley, January 4, 1843.

P. S. In reading over your Notices of Patents, I recollect having seen in one of your back Numbers, under the head "Steam-Engine Improvements," a claim laid to the invention of a governor, as applied to the safety valve of marine boilers, in order to relieve the valve of part of the weight every time the engine stops, as a preventive against explosions; your Magazine, however, will bear ample testimony to my claims of priority—*vide*, vol. xxxii. page 103.

W. W.

GAS-LIGHTING.*

We have now two pamphlets before us, which may be regarded as indicating, in rather a remarkable manner, the stage at which gas-lighting has arrived in England. One, which is from the pen of our old and much-esteemed correspondent Mr. I. O. Rutter, has for its object to clear away the doubts and prejudices which still prevail so extensively as to the applicability of gas-light to private houses, (that is, in England *proper*, for in the principal cities and towns of Scotland, gas is already nearly as much used for domestic purposes as for the lighting of streets, factories, shops, &c.) The other, by Mr. Henry Flower, is intended to show that the gas-meters, by which it has been commonly supposed the past progress of gas lighting has been wonderfully accelerated, from their establishing an infallible measure of the advantages conferred by gas companies or their customers, are, after all, mere instruments of trickery and imposture.

Mr. Rutter's Treatise calls for little else than an earnest recommendation of its contents to the attention of all gas light companies and consumers on this side of the Tweed. The former will learn from it how, by the mere spread of just notions on the subject of gas-lighting, their dividends may be more than doubled and tripled; and the latter, how foolish it is in them to tarry a single day under the fuliginous and filthy dominion of wax and tallow, after the modern Athenians, and even the most Bœotian of their compatriots, have so satisfactorily demonstrated that people have but to will it, to make their houses radiant with a light, second only to that of the sun itself, for intensity, safety, and cheapness. The gas companies could not do a wiser thing, for their own interests, than to distribute, gratuitously, copies of Mr. Rutter's treatise throughout their respective districts.

Mr. Flower's production demands a more particular notice. It is cleverly and plausibly written; but, in our humble judgment, in a most uncandid spirit, and with very sinister views. The author knows, evidently, what he is about; but we do not think he would like all the world to be as well informed in that respect as he is himself. His *ostensible* purpose is to get up an outcry against the companies, on the ground of their patronising a mode of measuring their supplies to the public, which they *know* to be false, and make use of *because it is so*. His *real* purpose we take to be something very different—one which, though veiled from observation at present, by protestations of exclusive anxiety for the public weal, would probably become apparent enough, *were all the meters now patronized by the companies once got rid of*. That the charge brought by Mr. Flower against the companies is most unjust, a very few words may suffice to show. Every one, who knows any thing of the history of gas-lighting, knows that the plan of measuring by meters the gas supplied to customers, did not originate with the companies, and was not assented to by them, till after a good deal of opposition and delay on their parts—not, in fact, till it was literally forced upon them by the pressure of public opinion, under a strong conviction, on the part of the public, that there was no other possible way of protecting consumers from the most extortionate charges on the part of these great chartered monopolists. The meter first adopted by the companies was the *water* meter, invented by Mr. Clegg, (afterwards known, from the name of the manufacturer, as *Crosley's*,) and this simply because it was universally thought at the time to be the best. So far, therefore, it is clear that the companies could have had no intention of taking any advantage of the public. Faults, it is true, have been since found with the water meter, and several good methods have been suggested of remedying them—Mr. Botten's,

* Advantages of Gas-light to Private Houses. By I. O. N. Rutter, Esq., F.R.S.A., Engineer to the Old Brighton Gas Company. Parker, London.

Gas Meters; their Unfairness demonstrated, and the Loss arising to the Consumers of Gas by their use pointed out. With Instructions for Proving their Deficiency of Measure, and Directions for Keeping a Meter in Order. By Henry Flower. Second Edition. To which is added, the Method of Naphthalizing and thoroughly Purifying Coal Gas. 20 pp. 8vo. Mann, London.

for example, of which we gave a description in our 932nd Number. But meters are not cheap articles, and after a large town has been once supplied, the introduction of new meters, no matter what their superiority may be, is necessarily a work of time. No one could reasonably expect of any company to furnish all their customers with new meters, at every new step made, or supposed to be made, in the progress of invention. The utmost that we ought to hope from them, is, that when new meters are wanted for customers, they will prefer those which are of the newest and most approved fashion; and we have yet to learn that the companies have shown any culpable unreadiness in this respect. Mr. Flower does not accuse them of anything of the sort, and seeing how willing he is to bespatter them if he can, we may be sure that if there had been any ground for charging them with opposition to the adoption of new improvements, he would have found it out. His objection is to the *water* meters altogether. He affects to regard them as radically false in principle, and incapable by any change or modification of registering correctly the gas that passes through them. How they have been improved, or how they might be improved, or how far the companies have exerted themselves to improve them, he never troubles himself to inquire. He takes some of the oldest and worst he can find, for fair specimens of the whole, and throws on the companies who but adopted this system of measurement at the bidding of the public, the blame of all the unfairness which he is pleased to impute to it. And because, forsooth! the companies do not think fit to take any notice of his attacks upon them, he thinks "it may *fairly* be said that they have let judgment go by default." We think the companies do quite right, and need be in no fear that an impartial public will, under such circumstances, infer anything to their prejudice from their silence. A person who asks another to meet him in the field of fair inquiry, but begins by calling that other rogue and scoundrel, has no right to the courtesy of a meeting. Nor would any but the veriest simpletons be seriously influenced by anything that could fall from so outrageous a swaggerer.

What would Mr. Flower have, if he could have all his own way? Supposing the water meters were as incurably faulty as he alleges, what then? Must the attempt to supply by measure be altogether abandoned, or must *water* measuring only be abandoned? On this point of the *what then*, Mr. Flower preserves a profound, but to us by no means mysterious silence. Of late, there has been a good deal said about the advantages of certain *dry* meters, and at the tail (where stings usually lie) of Mr. Flower's preface, there is the following notice of one of the class, which, though slight, is because of that very slightness, only the more pregnant of meaning.

"I regret that I have not had an opportunity of testing Mr. Defries's patent dry gas meter. It is upon a very excellent principle, but I can only speak *quoad hoc.*"

Propter hoc — Mr. Flower! Now the murder's out.

We have ourselves a very favourable opinion of the dry meter system, and think it likely that it will ultimately supersede the other; but, if it be really the better of the two, and if Mr. Defries's meter be the best of the class, (for there are others) there is no need of hireling pamphleteers, or volunteer traducers, to make all this speedily apparent to the world.

When reading the charges of fraud which Mr. Flower fulminates so boldly against the companies, we expected to come at last upon some astounding exposure of enormous profits made by the fraud practised. No such thing. Mr. Flower does not, because he could not, in opposition to notorious facts, allege that the Gas Companies make more on an average than the common rate of interest on their invested capitals. According to Mr. Flower, the companies practise roguery purely for the roguery's sake; and this, though there be among the directors of these companies some of the most respectable and respected men of nearly every city and town in the kingdom. *Post hoc*, Mr. Flower—no more need be said.

We may not unfitly take this opportunity

of calling attention to certain unoccupied fields (not adverted to in either of the pamphlets before us) which one would least of all expect to find, at this time of day, strangers to the advantages of gas-lighting. We allude to our public dock-yards and arsenals. When at Portsmouth lately, we were astonished to see the vast dock-yard at that place, enclosing many millions' worth of public property, no better illuminated at night than in the farthing rushlight days of our grandfathers, when the chief duty of lamps out of doors seemed to be to make "darkness visible;" and, on enquiry, we were informed that the same is the case in all the other yards. Strong detachments of the new police have been introduced to assist in the watching and warding of these establishments; but the introduction of lighting by gas, which experience has shown to be so incomparable an auxiliary in the protection of persons as well as property during the darkness of the night, is most unaccountably, if not culpably, delayed. The neglect of Government in this respect will appear the more reprehensible, when it is considered how peculiarly liable such places are to be the scenes of midnight accident, pillage, and disaster, from their numerous open quays and basins—immense building slips, involved in thickest gloom by the roofs erected to protect them from the weather—and huge piles of building, nearly all filled with stores of the most combustible description. Witness the destructive fires which took place some time ago in the Portsmouth and Sheerness yards, on the mystery attending which, two or three well-planted gas lamps would probably have thrown more light than a dozen courts of enquiry—if, indeed, they would not have prevented their occurrence altogether. Witness, too, the numerous lives which have been lost or placed in jeopardy in these dock-yards, from persons missing their way in dark and foggy nights, and walking into their unfenced excavations—these persons, too, being of the very number of those set to watch over them—men sacrificed in the performance of their duty, simply because their superiors choose to keep behind all the rest of the world in the march of improvement. The melancholy fate of Ensign Rushbrooke, (son of Colonel Rushbrooke, M. P.,) and a relief sentinel under his command, who were thus drowned in one of the basins of the Portsmouth Yard, must still be fresh in the recollection of many of our readers. Nor will they probably have forgotten, how at the last fire in the Woolwich Yard, which happened during an intense fog, a gallant volunteer from one of the ships in the river lost his life in the same way, and several marines, who tumbled into the basin after him, were only rescued with the greatest difficulty. Witness farther the annual loss from nightly thievery, which notoriously takes place in all our dock-yards, one tithe of the amount of which would probably suffice to pay for all the gas-light that would be required to make such thievery, to any serious extent, next to impossible. We have heard—but can hardly believe it to be possible—that it is not so much insensibility to the advantages of gas-lighting, as certain marvellously narrow considerations of economy, which stand in the way of its adoption by the Lords Commissioners of the Admiralty. Tenders, it is said, were obtained for lighting one of our principal dock-yards, and the question of acceptance decided in the negative, by a matter of considerably less than 30*l.*! If this be true, or whether it be true or not, we hope that another session of parliament will not be suffered to pass, without a strict enquiry being made into the real causes of a state of things so inexcusable and disgraceful.

We believe that some, if not all of our mercantile dock companies, are just as much to blame, in this respect, as the Commissioners who have the superintendence of Her Majesty's dock-yards. We read, the other day, of a tide-waiter losing his life while doing duty in the London Docks, from falling into the Hermitage Basin; the night was pitch dark, and there were no gas-lights to guide him in his rounds. Had the unfortunate victim been any other than a poor tide-waiter—a chairman, or deputy-

chairman of directors, for instance—we should perchance have had the consolation to see lamps forthwith erected at every turn and corner of the London Docks, that no more *brother* directors might tumble in; but, as things go, it is but tide-waiters, and such like, whom nobody knows or cares for, that perish from the non-lighting of these docks; and non-lighted we suppose they will remain, till something worse, *or better*, happens.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN BEVAN, OF CHELSEA, GENT., *for an improved mode of expelling the air from certain cases or vessels used for the preservation of various articles of food.* Patent dated, April 6th, 1842. Specification enrolled, October 6th, 1842.

By the methods commonly followed in the manufacture of preserved meats, the air is expelled from them by the application of external heat at very high degrees of temperature, by which the quality of the meat is stated to be injuriously affected. Mr. Bevan pursues a different process. The meat being packed in an air-tight case as usual, he connects the case by a metal tube, with an air-exhausting apparatus, and by another metal tube, with a vessel containing gelatine in a state of warm solution. As the exhausting apparatus extracts the fixed air from the meat through one tube, the warm gelatine rushes in through the other tube to supply its place. The case is then hermetically closed by cutting and pressing, or nipping the tubes at the parts of insertion; after which it is submitted to boiling water for a longer or shorter period, according to its size (in the case of a fowl, thirty minutes is stated to be sufficient). It is then allowed to cool, when the process is complete.

HENRY BEAUMONT LEESON, OF GREENWICH, M.A. AND M.D., *for certain improvements in the art of depositing and manufacturing metal and metal articles by electro-galvanic agency, and in the apparatus connected therewith.* Patent dated, June 1, 1842. Specification enrolled, Dec. 1, 1842.

Dr. Leeson's improvements are thirteen in number. He claims 1st, a new method of constructing the galvanic battery, of which the distinguishing feature is a particular mode of placing or constructing the metal bars connecting the cathode and anode plates, so that one plate can be readily removed or changed without disturbing the remainder; together with a new mode of supporting and arranging the porous cells in one frame, so that the whole can be at once removed. 2. The application of a galvanic battery for the purpose of cleaning the zink and copper plates used in any battery, and for the purpose of depositing mercury upon the zink plates. 3. The application of the electro-lytic fluids for the purpose of exciting an electric current, to be used in the deposition of metal. 4. The use of what is termed an "intensity arrangement," for the purpose of obtaining a good metallic deposit, which arrangement consists in the use of a galvanic battery, composed of more than ten pairs of plates. 5. A method of manufacturing works of art, and other articles in silver, by depositing the metals upon moulds of wax, plaster of Paris, and other non-conducting or badly conducting surfaces, by means of a strong solution of cyanide of silver and potassium, and the use of elastic moulds, for the purpose of producing casts to be employed in the processes of electro-deposition. 6. The giving motion to the surface to be deposited upon, or to the electro-lytic fluid in which such surface is immersed during the period of electro-deposition. 7. The application of the electro-deposition of metals and metallic alloys, to the formation of reflecting surfaces of parabolic and other reflectors and specula. 8. A method of depositing metallic *alloys*. 9. A method of preparing metallic surfaces for electro-deposition, by previously covering the same with a slight coating of metallic mercury. 10. A method of arranging the articles to be deposited on, so as to assist in generating and maintaining the galvanic current. 11. A method of depositing metals by the aid of electrolytic solutions, not originally containing such metals as component parts thereof, when in conjunction with a cathode of the metal to be deposited. 12. The use of electro-deposition when employing the cathodes as a means of manufacturing platinum and other metals from their respective ores. And 13. The application of electro-deposition to the manufacture of vessels and other articles of platinum, or to the covering metal and other surfaces with platinum.

KENT KINGDON, OF EXETER, CABINET-MAKER, *for certain improvements in impressing and embossing patterns on silk, cotton, and other woven or felted fabrics.* Patent dated, April 7, 1842. Specification enrolled, October 21, 1842.

To produce a flock-embossed cloth:—The patentee takes any plain piece of cloth and stamps it of the required pattern by means of a wooden block, on which the

pattern is engraved in relief, and the raised parts of which have been previously done over with a solution of caoutchouc; after this caoutchouc solution has become dry he spreads over it what is known by the name of flocking varnish, and then dusts the flock on the varnished parts, to which it permanently adheres.

To produce a bronzed or gilt cloth:—The cloth is done over first with a solution of caoutchouc, and then with a gold size made in the usual way, which may be either gilt or bronzed; the embossing is then effected either by means of flock in the way before described, or by passing the cloth through engraved cylinders.

James Boydell, Junior, of the Oak Farm Works, Dudley, Iron Master, *for improvements in the manufacture of keel-plates for vessels, iron gates, gate-posts, fencing and gratings.* Patent dated, May 24, 1842. Specification enrolled, October 24, 1842.

"Keel-plates" are at present fashioned of any desired form by means of hand hammering, with the aid sometimes of heat. Mr. Boydell passes the plates through rollers suitably formed for that purpose, and is thereby, he says, enabled to produce both better and cheaper keel-plates.

"Iron gates, fencing, and gratings" he manufactures by first placing the bars or other parts of which they consist, in their intended positions, and binding them together with wire or wood clamps; then heating them in a furnace to a good welding heat which consumes the ligatures, and causes the pieces of iron to run sufficiently together at the parts of intersection to allow of their being removed on a truck from the furnace to the rollers, by introducing them carefully between which they are securely welded together in all parts.

"Gate-posts" are to be improved by casting enlarged feet thereon, formed of the liquid scoria or cinder of iron works.

Samuel Hall, of Basford, C.E., *for improvements in the combustion of fuel and smoke.* Patent dated, May 9, 1842. Specification enrolled November 9, 1842.

The improvements which form the subject of this patent are stated to be supplementary to those described under Mr. Hall's previous patents, relating to combustion, of 1836, 1838, and 1841. The *first* consists in certain "peculiar" arrangements for supplying atmospheric air to furnaces through a great number of passages, or in a greatly divided state. The air is first introduced through a great number of tubes standing vertically at the outer or chimney end of the furnaces, the different streams from which reuniting, pass into one column along a hollow chamber *under* the main flue until it arrives at the bridge, where, in a considerably heated state, it is divided into two currents, which are carried one on each side round the brick-work or fire-place enclosing the burning fuel, and admitted into the fuel through a number of orifices in the brick-work and the fire-door. The *second* improvement consists in producing a more rapid combustion in the furnaces of locomotive engines, by admitting through various channels, atmospheric air to the carbonaceous parts of the fire as well as to the volatile parts. A *third* consists in causing a draught through the fire of locomotive engines when the engines are stopped, or before they are set to work, by means of a pipe which proceeds from the front of the locomotive to the chimney, and passing up that is connected to another pipe, which is to be dipped into the boiler of any other locomotive at hand which happens to have its steam up. A *fourth* consists in preventing the escape of sparks from locomotive chimneys, by throwing up jets of water from time to time into the chimney, by means of a perforated pipe connected to the force-pump; and intercepting those sparks which are not so quenched by means of a perforated hood, the aggregate amount of the holes in which is to be greater than the area of the chimney.

William Young, of Queen-street, London, Lamp Maker, *for improvements in lamps and candlesticks.* Patent dated, May 28, 1842. Specification enrolled, November 28, 1842.

The improvements in lamps consists in producing a ring-flame, by means of a number of separate wicks heaped together, the interstices between which admit the air necessary for the support of the flame, and some subordinate contrivances, not of much novelty, for regulating the height of such wicks.

The improvements in candlesticks consist in several ingenious additions to the already sufficiently numerous class of "save-alls," and equal to any of them, we dare say, in "candle-end" utility.

John Robinson, of Watney-street, Commercial-road East, Engineer, *for improvements in windlasses and capstans.* Patent dated, May 3, 1842. Specification enrolled, November 3, 1842.

The first of these improvements, (which are no less than thirteen in number,) consists in making use of two barrels, one of which is half the size of the other, with guiding pulleys between. The reader acquainted with this class of machines will see, at once, that this is but the old Chinese windlass revived. The second is also an old acquaintance—the fusee windlass—with this

difference, that the conical barrel has a number of bits or stops inserted in the face of it, in a spiral direction, to prevent the cable, (we suppose,) from being run off too quickly. The third is a guide-plate, to regulate the running out of the cable. The fourth consists in making the cross-heads for working the barrels of windlasses, (where such cross-heads are used,) of four bars instead of two. The fifth, sixth, and seventh embrace three different modes of giving motion to windlass barrels—two of them by means of bands or straps, and the third by toothed surfaces. The eighth consists in employing a second barrel, with grooves, for the purpose of keeping the cable straight—another modification of the Chinese windlass, with the grooves substituted for the intermediate pulleys. The ninth is the Chinese windlass again, according to a third modification. The tenth improvement consists in throwing the nipping parts out of action by lowering the cross-head, and raising the palls by means of a semicircular gripper acted on by a handspike. The eleventh is a mode of giving motion to a windlass through the medium of a capstan. The twelfth is the substitution of two eccentrics for the ordinary crosshead And the thirteenth is a new mode of working capstans, through the intervention of a revolving tube, and a couple of wheels and pointer.

WATERLOO BRIDGE TOLLS.

Sir,—In perusing your Number for Jan. 14, I was greatly struck by the assertion, that the reduction of toll on Waterloo bridge had *not* been productive of any increase in the number of passengers; and at first supposed, as no doubt you did yourself, that the numbers furnished by "a proprietor and annuitant," were numbers of individuals: but, on closer inspection, I find they are *pounds sterling*, which greatly alters the affair. 15,657*l.* given by the penny toll, shows 3,757,680 individuals to have paid toll; but 14,534*l.* given by the halfpenny toll, shows 6,976,320 persons to have passed, being not very much below the *double* of the previous number. The policy of the reduction as regards the proprietors, I am not prepared to defend; but I think this short statement will show its effect on the public, which is just what all previous experience would lead us to expect.

I remain, Sir,

Your obedient Servant,

AN INSPECTOR.

["Inspector" is right. We were misled, as he was at first, by the way in which the figures were presented to our view Ed. M.M.

DESTRUCTION BY GUNPOWDER OF THE ROUND-DOWN CLIFF ON THE LINE OF THE SOUTH-EASTERN RAILWAY—ONE MILLION OF TONS BLOWN UP.

[Abridged from Report in the *Times*.]

Dover, Thursday, 5 P. M.

"The experiment has succeeded to admiration, and, as a specimen of engineering skill, confers the highest credit on Mr. Cubitt, who planned, and on his colleagues who assisted in carrying it into execution.

"Everybody has heard of the Shakspeare Cliff, and I have no doubt that a majority of your readers have seen it. I should feel it a superfluous task to speak of its vast height, were not the next cliff to it, on the west, somewhat higher. That cliff is Round Down Cliff, the scene and subject of this day's operations. It rises to the height of 375 feet above high-water mark, and was, till this afternoon, of a singularly bold and picturesque character. To understand the reasons why it was resolved to remove, yesterday, no inconsiderable portion of it from the rugged base on which it has defied the winds and waves of centuries, I must make your readers acquainted with the intended line of railroad between Folkestone and this place.

"At Folkestone there will be a viaduct of great height and length. Then there will be a tunnel, called, from a martello tower near it, the Tower Tunnel, one-third of a mile in length. Then comes a cutting through the chalk of two miles in length, called Warren's Cutting. Then comes the Abbott's Cliff tunnel, one mile and a quarter in length, and now half finished, although only commenced on the 16th of August last. From the Abbott's Cliff tunnel to the Shakspeare Cliff tunnel, the railroad will be under the cliffs close to the sea, and protected from it by a strong wall of solid masonry two miles long, and with a parapet of such a height as will not preclude passengers from the splendid marine view which lies under them. Now it was found that when a straight line was drawn from the eastern mouth of the Abbot's Cliff Tunnel to the western mouth of the Shakspeare Tunnel, there was a projection on the Round Down Cliff which must be removed in some way or other to insure a direct passage. That projection, seen from the sea, had the appearance of a convex arc of a circle of considerable diameter. It is now removed, and some idea of its size may be formed from the fact that a square yard of chalk weighs two tons, and that it was intended by this day's experiment to remove one million tons. The Shakspeare Tunnel is three-quarters of a mile long, and

it is about the same distance from that tunnel to the town of Dover.

"Having premised thus much as to the locality of Round Down Cliff, I now proceed to describe, as briefly as I can, the means employed to detach from it such an immense mass of solid matter. Three different galleries, and three different shafts connected with them, were constructed in the cliff. The length of the galleries or passages was about 300 feet. At the bottom of each shaft was a chamber 11 feet long, 5 feet high, and 4 feet six inches wide. In each of the eastern and western chambers 5,500lb. of gunpowder were placed, and in the centre chamber 7,500lbs., making in the whole 18,000lbs. The gunpowder was in bags, placed in boxes. Loose powder was sprinkled over the bags, of which the mouths were opened, and the bursting charges were in the centre of the main charges. The distance of the charges from the face of the cliff was from 60 to 70 feet. It was calculated that the powder, before it could find a vent, must move 100,000 yards of chalk, or 200,000 tons. It was also confidently expected that it would move one million.

"The following preparations were made to ignite this enormous quantity of powder:— At the back of the cliff a wooden shed was constructed, in which three electric batteries were erected. Each battery consisted of 18 Daniels' cylinders, and two common batteries of 20 plates each. To these batteries were attached wires which communicated at the end of the charge by means of a very fine wire of platina, which the electric fluid, as it passed over it, made red-hot, to fire the powder. The wires, covered with ropes, were spread upon the grass to the top of the cliff, and then falling over it were carried to the eastern, the centre, and the western chamber. Lieut. Hutchinson, of the Royal Engineers, had the command of the three batteries, and it was arranged that when he fired the centre, Mr. Hodges and Mr. Wright should simultaneously fire the eastern and the western batteries. The wires were each 1,000 feet in length, and it was ascertained by experiment that the electric fluid will fire powder at a distance of 2,300 feet of wire.

"Exactly at twenty-six minutes past two o'clock, a low, faint, indistinct, indescribable moaning subterranean rumble was heard, and immediately afterwards the bottom of the cliff began to belly out, and then almost simultaneously about 500 feet in breadth of the summit began gradually, but rapidly, to sink. There was no roaring explosion, no bursting out of fire, no violent and crashing splitting of rocks, and, comparatively speaking, very little smoke; for a proceeding of mighty and irrepressible force, it had little or nothing of the appearance of force. The rock seemed as if it had exchanged its solid for a fluid nature, for it glided like a stream into the sea, which was at a distance of about 100 yards—perhaps more—from its base, filling up several large pools of water which had been left by the receding tide. As the chalk, which crumbled into fragments, flowed into the sea without splash or noise, it discoloured the water around with a dark, thick, inky-looking fluid; and when the sinking mass had finally reached its resting place, a dark brown colour was seen on different parts of it, which had not been carried off the land. I forgot to minute the time occupied by the descent, but I calculate that it was about four or five minutes. The first exclamation which burst from every lip was, "Splendid, beautiful!" the next were isolated cheers, followed up by three times three general cheers from the spectators, and then by one cheer more."

NEW PUBLICATIONS ON THE ARTS AND SCIENCES PUBLISHED IN JANUARY, 1843 *

Proceedings of the London Electrical Society, Session 1842-3. Edited by the Secretary. Part 7.

Advantages of Gas Light in Private Houses. By J. O. N. Rutter, F.R.A.S., Engineer to the Old Brighton Gas Company—32mo.

Gas Meters: their Unfairness Demonstrated. By Henry Flower—8vo.

Ensamples of Railway Making. By John Weale, 1 vol. royal 8vo., with 28 plates.

Principles and Practice of Land Engineering, Trigonometrical, Subterraneous, and Marine Surveying. By C. H. Bourns, C.E. 1 vol. 8vo., with maps, plans, and 118 diagrams.

Designs for Mosaic Pavements. By Owen Jones. Imperial 4 o., with plates in colours.

Elements of Electro-metallurgy, or the Art of Working in Metals by the Galvanic Fluid. By Alfred Smee, F.R S. (Complete.) 1 vol. 8vo., with numerous woodcuts.

The Doctrine of the Deluge; vindicating the Scriptural Account from the Doubts that have been recently cast upon it by Geological Speculations. By the Rev. Henry Vernon Harcourt. 2 vols. 8vo.

Scientific Wanderings, or Results of Observation and Experiment. Being an attempt to illustrate the Elements of Physics. By the Rev. R. Fraser. 1 vol. 18mo., with numerous woodcuts.

The Natural History of the Nectariniadæ, or Sun Birds. With portrait and memoir of Willoughby. By Sir William Jardine, Bart. (Naturalist's Library, Vol. 36.)

The Science of Drawing Simplified, or the Elements of Form demonstrated by Models. By B. Waterhouse Hawkins. With box containing the models, lettered "Hawkins's Rational System of Drawing."

Blunt's Civil Engineer and Practical Machinist. Two new Parts.

Observations on the Report of Lieut. Col. Sir Fred. Smith, R.E., and Professor Barlow, on the Atmospheric Railway. By Thos. Bergin, M.R.I.A.

The Report of the South Shields Committee, ap-

* To be continued monthly.

pointed to Investigate the Causes of Accidents in Coal Mines. With Plans and Appendix.

Periodicals devoted to the Arts and Sciences, and Contributions by Miscellaneous Periodicals.

The Philosophical Magazine.

The Civil Engineer and Architect's Journal, No. 64.

The Architect, Engineer, and Surveyor. No. 36.

Annals of Chemistry and Practical Pharmacy, No. 14.

The Chymist. By Charles and John Watt. No. 1., New Series.

The London Journal, and Repertory of Arts, Science, and Manufactures; containing the specifications and descriptions of new patent inventions. No. 133.

The Repertory of Patent Inventions. No. 1., Enlarged Series.

The Record of Patent Inventions. No. 4.

The Practical Mechanic, and Engineer's Magazine. (Glasgow.) Part 17.

Edinburgh Review, No. 154.—Art. 1. History and Practice of Photogenic Drawing, or Drawing by the Agency of Light.

United Service Magazine (Colburn's) No. 170.—Art. 1. Naval Improvements of the Nineteenth Century.

Illustrated Polytechnic Review, No. 1., contains Description of Osler's self-registering anemometer, improved by Newman. No. 2. Description of Newman's and other barometers—On Leyden discharges and Lightning Flashes. By Charles Walker, Esq.

Athenæum, Jan. 14, 21, 28,—Professor Cockerell's Lectures on Architecture at the Royal Academy.

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 29TH OF DECEMBER, 1842. AND THE 26TH OF JANUARY, 1843.

Edward Thomas, Lord Thurlow, of Ashfield-lodge, Ixworth, Suffolk, for an improvement or improvements in bits for horses and other animals. December 29; six months.

Benjamin Bailey, of Leicester, frame-smith, for improvements in machinery employed in the manufacture of stockings, gloves, and other framework knitted fabrics. December 29; six months.

John Stephen Bourlier, of Sherborn-street, Blandford-square, engineer, for certain improvements in machinery used in printing calicoes, silks, paper-hangings, and other fabrics. (Being a communication.) December 29; six months.

Joseph Rock, junior, of Birmingham, factor, for improvements in the construction of locks. December 29; six months.

Henry Samuel Rush, of Sloane-street, mechanic, for improvements in apparatus for containing matches for obtaining instantaneous light. December 29; six months.

Baron Victor de Wydroff, of Bracknell, Berkshire, for improvements in the construction of railways, and in wheels to run on railways, and in apparatus for clearing the rails. December 29; six months.

John Bishop, of Poland-street, Westminster, jeweller, for improvements in apparatus for portioning steam-power; and also improvements in plugs cocks, or taps for steam, gases, and liquids. December 29; six months.

Crawshay Bailey, of Nant-y-Glo iron-works, Monmouth, esquire, for certain improved constructions of railways for tramways and railways. January 11; six months.

James Harvey, jun., of Regent-street, goldsmith, for certain improvements in steam-engines. (Being a communication.) January 11; six months.

William Ritter, of 106, Fenchurch-street, gentleman, for improvements in crystallizing and purifying sugar. (Being a communication.) January 11; six months.

William John Loat, of Clapham, builder, for an improved mode of constructing floors and roofs. January 12; six months.

Julian Edward Disbrowe Rodgers, of Upper Ebury-street, chemist, for certain improvements in the separation of sulphur from various mineral substances. January 12; six months.

Pierre Armand Lecount de Fontaine Moreau, of Skinner's-place, Sise-lane, for a certain process or processes of combining clay with some other substances, for the producing of a certain ceramic paste capable of being moulded into a variety of forms, and the application thereof to several purposes. (Being a communication.) January 14; six months.

James Harvey, of Bazing-place, Waterloo-road, timber merchant, for improvements in paving streets, roads, and other places, some of which improvements are his own invention, and others have been communicated to him by a foreigner residing abroad. January 14; six months.

William Snell, of Northampton-square, gentleman, for improvements in machinery for the manufacture of farina. January 14; six months.

Nathaniel Card, of Manchester, candlewick manufacturer, for certain improvements in the manufacture of candlewick, and in the machinery or apparatus for producing such manufacture. January 14; six months.

Henry Hussey Vivian, of Singleton, Glamorgan, Esq., and William Gossage, of Birmingham, manufacturing chemist, for certain improvements in heating or reducing ores of zink; also certain improvements in furnaces to be used for reducing ores of zink, part of which improvements are applicable to other furnaces. January 14; six months.

James Hamer, of Wardour-street, engineer, for improvements in propelling vessels. January 19; six months.

Thomas, Earl of Dundonald, of Regent's-park, for improvements in rotary or revolving engines, and in apparatus connected with steam-engines, and in propelling vessels. January 19.

Joseph Kirkman, junior, of Soho-square, pianoforte manufacturer, for improvements in the action of pianofortes. January 19; six months.

Thomas William Bennett, of Gray's Inn-road, timber-merchant, for improvements in paving or covering roads, streets, and other ways or surfaces. January 19; six months.

Luke Hebert, of Dover, civil engineer, for certain improvements in machines for grinding, and for dressing or sifting grain and other substances. January 19; six months.

William Bates, of Leicester, fuller and dresser, for improvements in the dressing and getting up of hosiery goods, comprising shirts, drawers, stockings, socks, gloves, and other looped fabrics, made from merino, lamb's wool, worsted, cotton, and other yarns, and in machinery for raising the nap or pile on the same. January 19; six months.

Thomas Sunderland, of Albany-street, Regent's Park, Esq., for improvements in moving floating bodies through water and air, and in accelerating the flow of water, air, and other fluids through shafts, pipes, and other channels. January 19; six months.

Uriah Clarke, of Leicester, dyer, for certain improvements in framework-knitting machinery, and a new kind of framework-knitted fabric. January 21; six months.

Frederick Albert Winsor, of Lincoln's-inn-fields, barrister-at-law, for new apparatus for the production of light. (Being a communication.) January 26; six months.

Charles Frederick Bielefeild, of Wellington-street, North Strand, papier-mache manufacturer, for improvements in suspending or hanging swing looking-glasses, and other articles requiring like movements. January 26; six months.

William Palmer, of Sutton-street, Clerkenwell, manufacturer, for improvements in the manufacture of candles. January 26; six months.

Henry Chapman, of Arundel-street, Strand, for a fabric for maps, charts, prints, drawings, and other purposes. January 26; six months.

Francis M'Gretrich, of Ernest-street, St. Pancras, artisan, and Matthew Bailey Tennant, of Henry-street, Regent's-park, gentleman, for improvements in apparatus for preventing engines and carriages from going off railways, and for removing obstructions on railways. January 26; six months.

Edward Smallwood, of North-lodge, Hampstead, gentleman, for improvements in covering roads, ways, and other surfaces. January 26; six months.

Robert Goodacre, of Ullesthorpe, gentleman, for certain improvements in weighing apparatus applicable to cranes or other elevating machines, whereby the weight of goods may be ascertained while in a state of suspension. January 26; six months.

James Boydell, Jun., of Oak Farm Works, Dudley, Stafford, iron master, for improvements in the manufacture of metals for edge tools. January 26; six months.

George Parker Bidder, of Great George-street, Westminster, civil engineer, for an improved mode of cutting that kind of slates, commonly called roofing slates, though sometimes used for other purposes. January 26; six months.

William James Greenstreet, of Blackfriars-road, gentleman, for certain improvements in machinery or apparatus for producing or obtaining motive power. January 26; six months.

Joseph Kirby, of Banbury, gentleman, for improved apparatus for manufacturing bricks, tiles, and other articles from clay, or earthy materials. January 26; six months.

George Phillips Bayly, of 146, Fenchurch-street, brushmaker, for certain improvements in brushes. January 26; six months.

Henry Phillips, of Exeter, chemist, for certain improvements in removing impurities from coal gas for the purposes of light. January 26; six months.

Martyn John Roberts, of Brynycæran, Carmarthen, Esq., for improvements in dyeing wool and woollen fabrics. January 26; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF DECEMBER 1842, TO THE 22ND OF JANUARY, 1843.

Gabriel Hippolyte Moreau, of Leicester-square, Middlesex, gentleman, for certain improvements in propelling vessels. Sealed, December 27.

Robert Wilson, manager at the works of Messrs. Nasmyth, Gaskell, and Co., Paticroft, near Manchester, Lancaster, engineer, for certain improvements in the construction of locomotive and other steam-engines. Sealed, December 27.

James Morris, of Cateaton-street, London, merchant, for improvements in locomotive and other steam-engines. (Being a communication from abroad.) Sealed, December 27.

Henry Samuel Rush, of Sloane-street, Middlesex, mechanic, for improvements in apparatus for containing matches for obtaining instantaneous light. Sealed, December 29.

John Rand, of Howland-street, Fitzroy-square, Middlesex, artist, for improvements in making and closing metallic collapsable vessels. Sealed, December 29.

Henry Beaumont Leeson, of Greenwich, Kent, doctor of medicine, for improvements in the art of depositing and manufacturing metals and metal articles by electro-galvanic agency, and in the apparatus connected therewith. Sealed, December 30.

Robert Logan, of Blackheath, Kent, esquire, for improvements in obtaining and preparing the fibres and other products of the cocoa-nut and its husks. Sealed, January 9.

James Gardner, of Banbury, Oxford, ironmonger, for improvements in cutting hay, straw, and other vegetable matters for the food of animals. Sealed, January 11.

Charles Hancock, of Grosvenor-place, Middlesex, artist, for certain improvements in printing cotton, silk, woollen, and other fabrics. Sealed, January 11.

Wilton George Turner, of Gateshead, Durham, doctor in philosophy, for improvements in the manufacture of alum. Sealed, January 12.

John Stephen Bourlier, of Sherborn-street, Blandford-square, Middlesex, engineer, for certain improvements in machinery used in printing calicoes, silks, paper-hangings, and other fabrics. (Being a communication from abroad.) Sealed, January 12.

William Wood, of Holborn, Middlesex, carpet manufacturer, for a new mode of weaving carpeting, and other figured fabrics. Sealed, January 13.

Matthew Gregson, of Toxteth Park, Liverpool, Lancaster, esquire, for an invention or improvement applicable to the sawing or cutting of veneers. (Being a communication from abroad.) Sealed, January 16.

Samuel Hall, of Basford, Nottingham, C. E., for improvements in the combustion of fuel and smoke. Sealed, January 18.

Joseph Beaman, of Smethwick, Harborne, Stafford, iron master, for an improvement in the manufacture of malleable iron. Sealed, January 18.

Alexander Johnston, of Hillhouse, Edinburgh, esquire, for improvements in carriages, which may also be applied to ships, boats, and other purposes where locomotion is required. Sealed, January 20.

Prizes for Scientific Essays.—The French Academy of Sciences have offered a prize of 6000f. for the best essay on the "Heat Disengaged during Chemical Combinations," to be delivered, addressed to the secretary, before the 1st April, 1845. Also a prize of 6000f. for an essay on the "Best Mode of Applying Steam to the Navigation of Ships, and on the best Mechanism, Form, &c., of the Ships, to which the Engines are to be Applied."

LONDON: Edited, Printed and Published by J. C. Robertson, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by W. and A. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

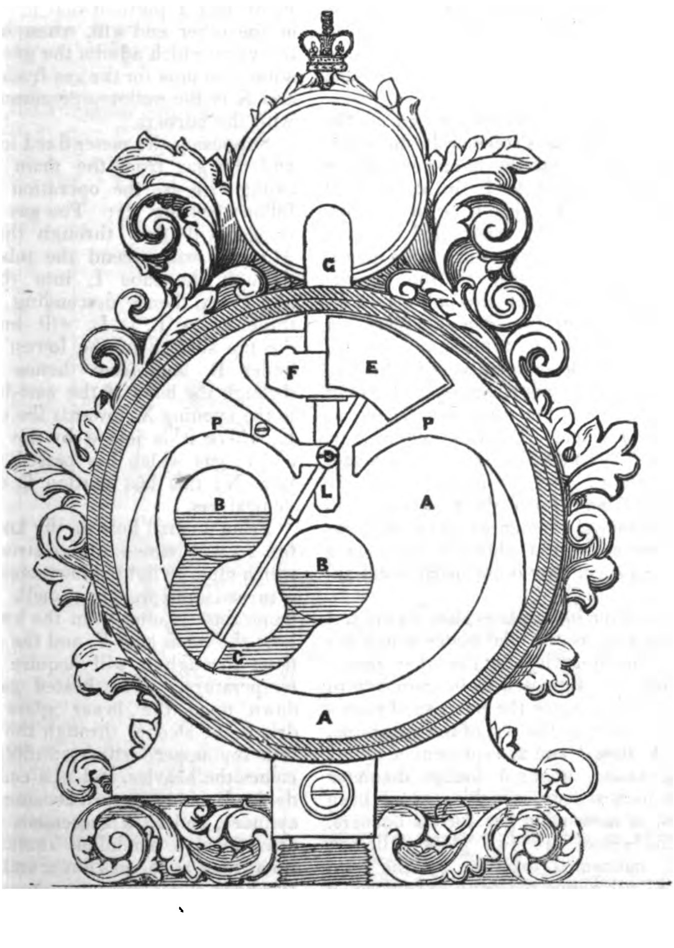
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1017.] SATURDAY, FEBRUARY 4, 1843. [Price 6d.]

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street. Double.

CLEGG'S DRY GAS-METER.

Fig. 1.



CLEGG'S DRY GAS-METER.

When discussing last week the subject of gas lighting, and gas-meters, we hinted that there were other dry gas-meters besides that of Defries (which seemed to us to constitute the *propter hoc* of the present outcry against the old water meters) that might possibly be possessed of equal merit. We now make good our point by laying before our readers a description of the *dry* meter of Mr. Samuel Clegg, the same ingenious and skilful engineer who invented the original water meter, and who has so honourably identified himself by that and numerous other important inventions with the rise and progress of the gas manufacture. It has, we believe, been the subject of two patents, but is now presented to our readers in its latest and most perfect form.

The instrument is constructed on the same principle as Professor Leslie's well known differential thermometer, and is not at all inferior to it in delicacy of performance. In size it is so diminutive, that a meter, capable of measuring six burners, called a six light meter, is but twice as large as the accompanying figures; and this admits of its being placed on the chimney piece, or any other convenient place in a room, where it may be constantly under the eye of the gas consumer, instead of being consigned, like the water meter, to the cellar or kitchen. The case, too, may be made of any material—as iron, bronze, or or-molu; and it may be cast or carved of any form desired, so as to render the gas-meter as great an embellishment to the chimney-piece as a clock, vase, or any other ornamental article.

The meter has a plate-glass front; but this, as well as the dial plates which indicate the quantity of gas that passes through, are supposed to be removed in our engravings, for the purpose of showing more clearly the rest of the apparatus.

A A, figs. 1 and 2, represent a cylindrical vessel, about 5 inches diameter and 4 inches deep, capable, as we have stated, of measuring gas for six burners. In this vessel are two glass cylinders B B, connected together by the bent tube C, all being perfectly exhausted of air. The cylinders being half filled with alcohol, are made to vibrate on centres D and D, and are balanced by the weight E. F is a hollow brass case, called the heater, about 2 inches long and half an inch broad, with a brass knob G projecting out of the meter. At the end of the heater is a tube I, connected with the vertical tube H at the back of the meter, through which the gas enters from the service pipe: and three tubes, L L L, convey the gas from the heater to the top of the (alternately) lowest glass cylinder. A pyrometer, W (which is simply a strip of brass soldered to a piece of steel spring, and bent in the form of the letter U), has one end attached to the heater F, in such a position that the collapsing of the other end will, when heated, lift the valve which admits the gas. J is the admission pipe for the gas from the main, and K is the outlet pipe communicating with the burners.

Supposing the meter fixed in its place, and the gas from the main communicating with it, the operation will be as follows (see fig. 2): The gas on its entrance will flow through the opening M; part will ascend the tube H, and through the tube I, into the heater, and from thence descending down the three pipes L L L, will impinge on the top surface of the lowest glass cylinder B, and from thence will pass through the body of the cast-iron meter to the opening X, towards the outlet pipe K, where it is joined by the other part of the gas which has passed along the tube N: this last portion is called the neutral gas.

From a small hole in the knob G (see fig. 2.) will issue a minute stream of gas, which must be lighted the moment the gas is turned on to prevent a smell. The small flame thus issuing from the knob G will heat the brass case F, and the gas which flows through it will acquire the same temperature. The heated gas flowing down upon the lower glass cylinder, drives the alcohol through the bent tube into the upper cylinder: this soon becomes the heavier, and will consequently descend, and in its turn become the lower cylinder, and by a succession of similar operations, a pendulous motion is kept up as long as the gas flows, and the jet in the knob G is burning; the number of vibrations in a given time exactly corresponding with the velocity of the gas,

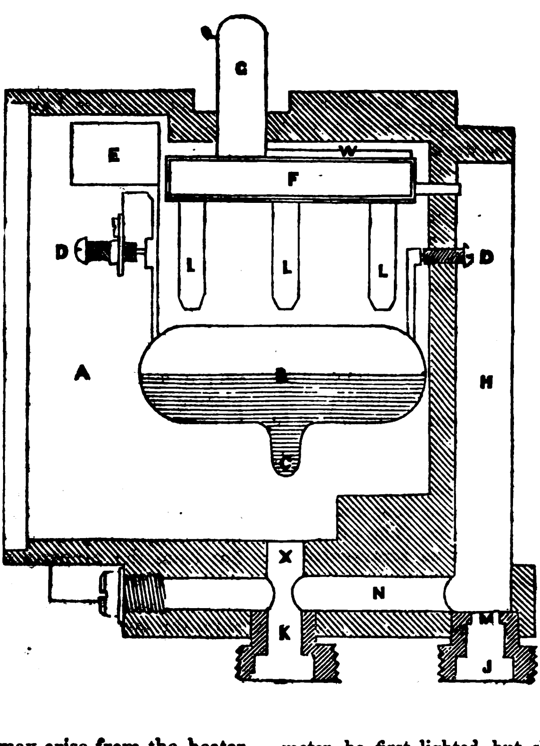
each vibration being communicated to a train of wheel-work, and thereby registered in the usual way.

When the brilliancy of the gas is increased, the caloric imparted to the heater is increased in proportion: *thus the quantity of light is measured* (the legitimate object of a gas-meter,) and encouragement is given to gas companies to make gas of superior brilliancy, greatly to the advantage both of vendors and consumers. The meter is adjusted with gas of medium quality; and to whatever extent the gas may exceed that, in illuminating power, it will be duly registered.

The pressure or temperature of the gas from the main, whatever it be, is stated to make no difference in the measure.

The cast-iron hoods P P, which project over the top glass cylinder, are made of such a thickness that their conducting power is sufficient to carry off any superfluous

Fig. 2.



caloric which may arise from the heater, so that the temperature of the heater, and the temperature of the hood which governs the top glass cylinder, bear always the same relative proportion to each other, whatever may be the temperature of the room in which the meter is placed.

The following "Directions" are given by Mr. Clegg for using this meter:—

"Let the meter jet, at the top of the meter, be first lighted, but should there be much atmospheric air in the service pipes, open a burner to discharge it previous to lighting the meter-jet: in about a minute after this has been done, one or all of the burners can be lighted.

"The main stop-cock should be placed as near the meter as can be got: for six burners it should not be more than half an inch in diameter, and in that ratio for other sizes.

"On the back of each meter is marked the number of lights it will supply. If this quantity of gas be much exceeded, the meter will go quicker in proportion; it will therefore be better for the consumer to take care to have a meter of proper size.

"The flame of the meter jet will, when so required, serve as a small light in any situation where the meter may be fixed, and this in many cases will be found very useful; but should such a light not be wanted, the meter jet (reduced by the adjustment of the main stop-cock to that height necessary only to work the meter for the usual burners) will in such case scarcely occasion the consumption of any measurable quantity of gas: yet in this state the minute flame of the meter-jet will be still useful for taking a light to seal letters or other purposes."

The meter is stated to be not suitable for measuring very small fractional parts: but taking the average of its indications for any period, as a quarter of a year, month, or even a week, it is considered to be "more accurate than any other meter."

The advantages claimed for this dry meter, are briefly these:—

1. Working without water.
2. Working without membranes or valves.
3. Working without requiring the least pressure.
4. Working without interference with the perfect steadiness of the lights.
5. Registering accurately, according to the illuminating power of the gas.
6. Occupying only one-sixth of the space of the common meters.
7. Being subject to no wear and tear.
8. And being cheaper. The price of a six light meter, such as represented in our engravings, is 2*l.* 2*s.*

THE TROUGH, OR AFTER CURRENT OF VESSELS IN MOTION, CONSIDERED IN ITS EFFECTS ON PROPELLING MACHINERY.

Sir,—An unexpected circumstance was developed in the course of some experiments made at Bristol on the *Archimedes*, with different sorts of propellers, which is noticed in your review of the "Appendices to Mr. Weale's new edition of Tredgold," (No. 993, August 20, 1842, p. 178) with the cause assigned by Mr. Galloway to account for it. The circumstance was this, that the vessel advanced a greater distance than, according to theoretical calculations, she ought to have done. I found a distinct reference to the same phenomenon in a very early Number of your Magazine, (No. 18, December 27, 1823, vol. i. p. 278,) by a correspondent signing "J. C. Gibbons," who accounts for the difference between steam-vessels going with and against tide, being less than theoretical considerations would make out, to the "stagnation" produced in their wake; but he seems to have had no clear perception of what caused the stagnation, which allowed watermen to row across the river in a direct line through the eddy of a steam boat, though the tide was running out with considerable force. Till the Bristol experiments, however, it does not appear to have attracted the attention of scientific men; it is to be hoped that a fact of so much importance in its probable results will meet with the investigation it deserves.

We all know that to propel a ship through water with any considerable degree of velocity, requires the application of great power, whether it be wind or steam, nearly the whole of which power is exerted in overcoming the resistance of the water in front of the vessel; in other words, in successively displacing the water which its own bulk is to occupy the place of. If a ship made its way through water as a plough advances in a furrow, leaving an open space behind it, the simple question to solve would be the amount of resistance offered to its progress by the water in front of it; but from the property of fluids to find their own level, another effect intervenes. In every successive advance made by the ship, the space it leaves is immediately occupied by water pouring into the trough left by the ship from behind, from above, and from the sides, or laterally, the joint direction of which is towards the end of the vessel; and by its motion in that direction against the hinder part of the ship, it assists in propelling or pushing it forward. Thus a portion of the power expended in displacing the water in front of the vessel is restored by the action of the water behind it, it being an instance in a modified form and degree, of the mechanical law of action and reaction.

The subject is one of much practical interest, more particularly with reference

to vessels propelled by machinery from behind, on which the after current may have a beneficial or adverse effect according to the propelling apparatus employed. From the mode of action of the paddle-wheel, the presumption is, that the tail or after current would exert an opposing, rather than an assisting influence on it, placed at the stern of a vessel, inasmuch as all the emerging floats, those which have passed the line of efficiency, and whose only office is to get out of the water with as little resistance as possible, would be exposed to the current setting in after the vessel, while the front or efficient floats would receive no benefit from it, for the reason that the strength of the current would have been chiefly wasted in buffeting with the emerging floats. There seems, therefore, an obvious objection to the employment of paddle-wheels at the stern of a vessel, and more particularly so if the stern has a full bluff form, in-instead of tapering by fine lines from the fore part of the vessel, as such fulness of form renders the current stronger immediately behind the vessel, and consequently in the way of the paddle-wheel.

But the very form which would be most objectionable if a paddle-wheel were employed, is that which would communicate the greatest beneficial effect of the after-current, to a vessel propelled by a screw from behind. The practical question, therefore, should be to obtain such an arrangement, as to the situation of the propeller, and the form of the hinder part of the vessel, as will concentrate the full effect of the after-current on them without deteriorating the sailing qualities of the ship in other respects.

The acting force of the screw-propeller is towards the water in the wake of the vessel, and its manner of action is by a quick rotary motion to project a conoidal volume of water, which, reacting by its pressure on the face of the screw, pushes it forward, and the vessel it is connected with. If the water in which this effect is taking place have also a motion of its own in the direction of the screw, a superadded impetus or pressure will be communicated to the screw, causing it to recede with increased velocity. The after-current formed by the water rushing in to occupy the trough or vacant space, left by the advancing vessel, should therefore be so directed that its full effect may be exerted against the face of the screw, and no part of it lost, or allowed to obstruct the receding of the screw. To show that this effect may take place, let. fig. 1 represent a horizontal section through the lower part of the hull of a ship in a line with the axis or shaft of the screw. It is obvious that as the end of the vessel is the centre of the trough towards which the water converges in the direction of the radial lines, if a screw-propeller be situated on the line A B, a very considerable portion of the current will be at A, the back of the screw, obstructing rather than assisting its recession. Though the preceding may be an extreme case, yet more or less of the same loss of effect or obstruction

Fig. 1.

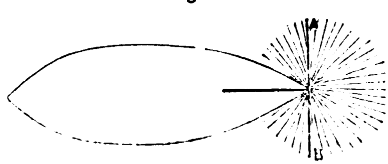


Fig. 2.

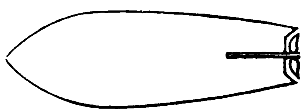
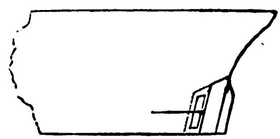


Fig. 3.



will be experienced if there be any open interval left between the end of the vessel and the screw, by which part of the trough-current may set in at the back of the screw. I would therefore propose a form of construction by which the end of the vessel shall project just beyond the screw, so that the latter shall work in a sort of recess, and the whole of the trough or after-current be brought to bear directly on the face of the screw, and the end of the vessel. This will be better understood by referring to the figures, of which fig. 2 is a horizontal section in the same plane as before, from which it will be seen that the screw being placed

in a recess, the trough-current can only act against the front of the screw and the bevelled or slanting sides of the recess, which being a truncated cone, of the depth of the screw, will present no obstruction or resistance to the "cone of motion" (as Mr. Hill designates it in your Magazine for September) formed in the water by the revolution of the screw, and it is calculated to receive the impact of such part of the after-current as is exterior to the circle of the screw's action. Fig. 3 is a vertical section of the end of the vessel, the dotted lines showing the recess containing the screw. The upper part of the vessel above the recess, with stern-post and rudder, are represented as according with the drawings of the *Great Britain*, by Mr. Hill, in your Magazine for September.

N. N. L.

THE BURNING FOCUS OF ARTIFICIAL LIGHT AT THE ROYAL ADELAIDE GALLERY.

"Hunt Nature into her elements."—*Akenside.*

"(243.) Cor. 4. If the rays which tend to form the sun's image, be received by a double convex lens, another image nearer to the lens, and consequently less than the former, will be produced. (Art. 223)."

"Hence it appears, that independent of the rays lost in their passage through the lens thus employed, *the burning power of a reflector, or a refractor, may be increased.*"—*Wood's Optics.*

Magdalen College, Cambridge,
January 1843.

My dear friend,—In reply to the inquiry in your kind letter, I have the gratification of being able to answer you, that *I am the first* who ever in experiment created that burning focus of artificial light, by means of which such very remarkable effects are now every evening produced at the Royal Adelaide Gallery in London—the combustion of phosphorus, &c. &c.

I am also the first who ever tried an experiment on the heat of that wondrous focus, by ascertaining that, notwithstanding the effulgence of its concentration, it did not develope heat sensible to the hand; for almost in the first moment of its being brought into existence, in my fervid conjecture that it must have contained heat in combination with that effulgence, I placed my hand at the focal point to receive upon it the concentrated radiance. The mode of creating that focus, by the combination of the "colossal lens," the largest in the world, being three feet in linear aperture, with the great parabolic reflector, and the oxy-hydrogen gas-light, suggested itself to me in one of those reveries, dreamy visions, in which, as you well know, my mind habitually indulges, and floats in meditation on modes of submarine existence, and submarine illumination, to be genera'ed by scientific theorising, and mechanical construction of diving-machinery, and optical (to take a term from the musicians) "*instrumentation.*"

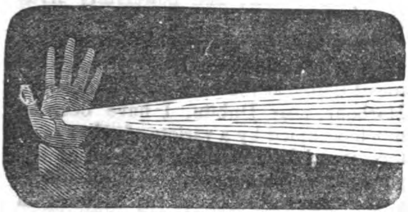
An account of the experiments which I made at the time, February 1840, was published in your own pages, and in the columns of the *Morning Chronicle:* this account stated what had been done, but did not state the fact, which is a reply to your inquiry, *viz.*, that I was the first person to whom it had occurred to combine the action of the lens, the parabolic reflector, and the oxy-hydrogen gas-light, for the purpose of creating a gorgeous focus.

I was most kindly aided in my different experiments by my three excellent friends, Mr. Maugham, Mr. Goddard, and Mr. Braddely, at that time scientific lecturers at the Gallery, and long before it came into the hands of the gentleman who is the present proprietor.

My principal experiment—as reference to the *Mechanics' Magazine*, or *Morning Chronicle* will show—was made for the purpose, as its primal object, of showing, that by the application of the new optical principle, which I had invented some time before, I could powerfully irradiate, and distinctly view, and show to others at the same time, the parts in succession of an object submerged either by day or by night, in very muddy water; *even placing that object at a great distance from the illuminating radiant.*

This was my primal purpose as connected with that department of physical science to which I have devoted so much of industrious, patient meditation, observation, and experiment; but, as I have already said, so strongly did I suspect that the radiance which had been generated in the focal point contained, and would even evolve sensible heat, my very first impulse the moment I viewed that concentrated effluence of light, was, even before trying my experiment in subaqueous illumination, to place my hand

in such a position that the focus should be formed on it.



Intent, however, on my primary object, the experiment in irradiation, on which I was keeping the effort of my mind in concentration, I did not then practically prosecute this investigation any farther by more rigorous experiment; but it was quite impossible to have brought into existence such a focus, without forming a conjecture almost amounting to conviction, that such a splendour could not co-exist with a temperature only equal to that of the circumambient air.

The result of the combination of the action of the giant lens and the oxy-hydrogen radiant in the focus of the parabolic reflector, produced a conception in my mind of an evocation, to take a form of expression from the Old Testament, of "THE SPIRIT OF FIRE!"

Perhaps the readers of your most useful pages may not be displeased to be informed that at the period when I was endeavouring to be useful in my generation by making those experiments, I was also occasionally getting some practical lectures in electricity, from a foreign professor of high and original scientific inspiration, then resident at the Royal Adelaide Gallery, but unfortunately since deceased — the huge electrical eel, who condescended to give me several very rude shocks, no doubt in compliment to my industrious researches in subaqueous science. He wished to patronise me for prosecuting those researches, which I did in his own element.

From the experiment in illumination, which has been described, is *directly derived* the principle of construction of "*the submarine focal illuminator*," for the use of divers in muddy or midnight, or *both* muddy *and* midnight waters. After some faint and wan "shimmering" on this subject in a kind of evanishing form, had presented itself to my perception in my hours of lonely meditation, I tried some experiments in Paris with muddy water, and the "piercing ray" of the oxy-hydrogen gas-light in its gorgeous glory; but it was in consequence of the utter failure of those experiments, that I was obliged to set my mind to work for the discovery of some entirely new principle in physical science by which I could achieve my object.

Locke, in his "Essay on the Human Understanding," quietly observes, that "truth is not so easily hewn out of the mine;" and I can assure any of your readers, who may think this letter worth the trouble of reading, that I was not able to hew the construction of "the Submarine Focal Illuminator" out "of the mine" at all "so easily" as some persons might imagine on looking at the diagram, and reading my description of the principle of construction.

There are cases in which either some unexpected train of thought, occupying the mind without effort, or some unanticipated circumstance—

> "Circumstance, that unspiritual god
> And miscreator,"

as it has been described by Lord Byron, in Childe Harold—gives a man a lift, a helping hand, in an intelligential investigation; but, in the case I allude to, the construction is the result solely of most industrious use (to avail myself of Locke's metaphor) of the mallet and the chisel, hewing it out of my brains by dint of patient, hard-working thinking.

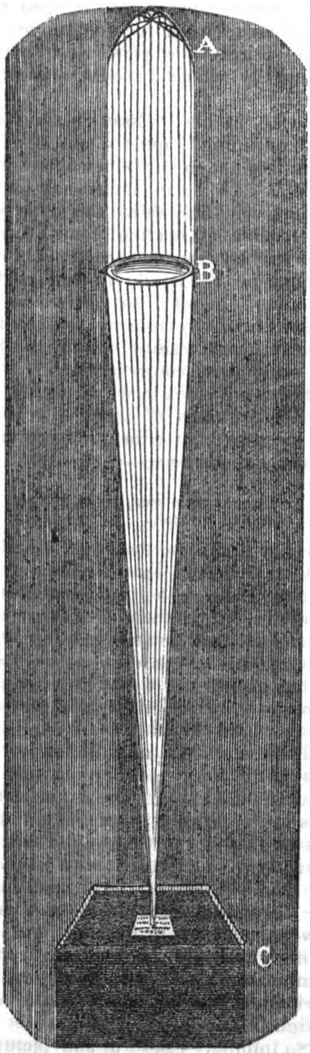
The exquisitely beautiful experiments now made every evening at the Royal Adelaide Gallery, by Dr. Atkin, with the lens and reflector, and oxy-hydrogen gas-light, not only fully confirm and verify my conjecture with respect to the combination of light and heat in the focus, but lead me to anticipate the development of many new and interesting results to be evolved from my combination; and that gentleman's experiments and his courtesy are equally delightful.

So infinitely beautiful and picturesque is his arrangement of the apparatus, that his experiment causing the phosphorus to flame up, appears to the spectator almost like a mystic spell:—I have named the focus, by reason of its lustre, THE CAMBRIDGE FOCUS.

DESCRIPTION.

The subjoined figure represents the entire combination of the action of the colossal lens, the parabolic reflector, and oxy-hydrogen gas light.

THE CAMBRIDGE FOCUS.



A is the parabolic reflector, and oxy-hydrogen gas light.

B, the enormous double convex lens, the largest in the world, 3 feet in diameter.

C, a glass tank filled with very muddy water; with a submerged manuscript brought into *contact* with the glass, and *therefore* visible, and powerfully *irradiated.*

Since my last communication, viz., an account of some experiments made by me at night, at the bottom of Kingstown Harbour, near Dublin, I have been so much occupied by a variety of other matters, that I have not had over-much opportunity of devoting myself to the affairs of the native element of my lecturer in natural electricity before alluded to; but I have not, however, been quite idle.

Descending by the ladder, in the water-tight dress and diving-helmet, on the wreck of the *Mary Rose*, at Spithead, I had an opportunity of *witnessing experimentally* the dreary gloom of those darksome waters, which had been described to me by the Messrs. Deane, Mr. Abbinett, and Mr. Peter Tall.

The wreck of the *Mary Rose*, sunk in the reign of Henry the Eighth, not very far from the spot where the *Royal George* afterwards went down, lies imbedded in the sand, in eight fathoms of water, in that " melancholy flood."

I have also descended at night, in the water-tight dress and diving-helmet, at that magnificent establishment, the Polytechnic Institution, in London, while one of the lecturers descended in the diving-bell, with an attendant, bringing down, at my request, the parabolic reflector, with a radiant in its focus.

The light was then sent gleaming into the water, through one of the clear plate-glass panes which form the little windows of that beautiful bell; and as, while standing upon the bottom—the water having been freshly pumped into the tank, and that night clear as crystal—I looked from out of the helmet through the glass eyes, and into the bell through the pellucid water and the clear window, the scene was one, to me, of exceedingly picturesque and gratifying interest.

There, was the parabolic reflector, in its radiance of " amber light;" and there, were the thoughtful visages of the two figures sitting in their subaqueous pavilion — " thoughtful visages," kindly anxious about the experiment; and there, was that amber light gleaming out dazzlingly through the window upon my eyes, and upon the metallic helmet, through the crystalline water!

The description of this subaqueous

scene may, perhaps, have but little to recommend it to the general reader, but it was a situation, to me, of very picturesque and delightful interest; as I believe I may venture to affirm that, for the last seventeen years, I have devoted more patient meditation, calm meditation,

"gliding onward like a lovely dream,"

to the subject of the creation of subaqueous illumination, for the use of divers, than any man who ever lived.

So much for light: and now a word with respect to the heat in the focus of the giant lens.

I pray permission most respectfully to suggest to Dr. Atkin to try the effect (in the combustion of the phosphorus) of the interposition of a second lens, in the manner described in the article from "Wood's Optics," at the head of this letter.

I believe that a lens, for the purpose of rendering more intense the torrid glory of the solar focus, was sent out with the great one made by Parker, as a part of the present from the sovereign of England to "the brother of the sun," the emperor of China.

Now, my dear and very kind friend, only to think that the sun—"the arch-chemick sun," as he is called by Milton—should be such an unnatural brother, that he would not give himself the trouble of burning a hole in an old hat, or fusing a halfpenny for his Imperial Majesty of the Celestial Empire, without the aid of optical instruments, sent out to China, all the way from England!!!

But,

"War, storm, and relations!"

says Lord Byron!

Locke, in his Essay on the Human Understanding, speaks of "those masses of knowledge which still lie hidden within the secret recesses of nature;" and the age in which we live has assuredly been both industrious and successful, in the development of some fractional portions of those "masses of knowledge" in their infinitude.

In Milton's *Paradise Lost*, the sun is apostrophised as while "with resplendent glory crowned," looking "from his sole dominion,"

"Like the god of this new world;"

and on the Liverpool railway, there is a locomotive engine, most felicitously named "*Talisman*." Yes, there is something intensely felicitous in the selection of the name. This name "TALISMAN," so applied, is calculated to pour a tide, a swelling ocean-tide of thought, on the human spirit! I ask, whether under the Talismanic spell of the steam-engine, man does not now "live, and move, and have his being," in an entirely "new world," and utterly different from the old one in which he existed formerly?

I speak of the magic spell of that "Talisman," both upon the ocean billows and on the railways, upon the rivers, and upon all other waters, and in manufactories.

Now for an example, a familiar, but yet a most striking example.

Go from London to Greenwich in about a quarter of an hour, by the railway, in a carriage drawn by a locomotive engine. Then, step into the steamer, constantly plying between Greenwich and Blackwall, and from Blackwall, run back to London in a few minutes by the railway in a carriage, deriving its motion from the stationary engine and the wire-rope.

In a few minutes after, if you are so disposed, by getting into one of the innumerable steamers plying for very cheap fares upon the river, you will be landed at "The Tunnel pier," and may saunter through "The Thames Tunnel," illuminated with gas, and with the river and the shipping passing over your head.

If you want to know to what a depth submarine and physiological science have enabled man to descend and work unwet beneath the waters of the sea, look in Westminster at some of the articles taken up from a depth of 25 fathoms in the Bay of Navarino, by means of that most interesting and original apparatus prepared under the direction of Mr. Alexander Gordon, of Fludyer-street. Then, finally, if you wish to complete a truly "Talismanic" excursion, go in a few minutes by a steamer from Westminster to Vauxhall, and there, in the stores attached to the gardens, view the famous and enormous-sized balloon, in which our dauntless friend Charles Green, that emperor of aerônauts, and most worthy man, went to Nassau through the air, and on a subsequent occasion was with Mr. Spenser in a situation not merely of terrific, but of unequalled, awful, horrific sublimity, after the descent of the parachute, when unfortunate Mr. Cocking was killed.

I do not use these words at random. After near six years of deliberation on the subject, I affirm, that in my opinion, the annals of human nature do not afford an account of a situation of such terrible sublimity, as that which I extract from the statement which Mr. Green, that

"Lord of the lion heart, and eagle eye,"

published at the time in the newspapers.

Here it is: it describes the *ne plus ultra* of scientific daring, and steadiness.

"Mr. Cocking to this question made no other reply than, 'Good night, Spencer; good night, Green.' At this instant I desired Mr. Spencer to take fast hold of the ropes, and, like myself, to crouch down in the car. In consequence of being compelled to keep hold of the valve line, of course I had but one hand which was available for the purposes of safety With that hand, fortunately, in the perilous situation into which we were speedily thrown, I was able to maintain my position. Scarcely were these words uttered before we felt a slight jerk upon the liberating iron, but quickly discovered, from not having changed our elevation, that Mr. Cocking had failed in his attempt to free himself. Another but more powerful jerk ensued, and in an instant the balloon shot upwards with the velocity of a skyrocket. The effect upon us at this moment is almost beyond description. The immense machine which suspended us between 'heaven and earth,' whilst it appeared to be forced upwards with terrific violence and rapidity through unknown and untravelled regions, amidst the howlings of a fearful hurricane, rolled about as though revelling in a freedom for which it had long strugged, but of which until that moment it had been kept in utter ignorance. It at length, as if somewhat fatigued by its exertions, gradually assumed the motions of a snake working its way with astonishing speed towards a given object. During this frightful operation, the gas was rushing in torrents from the upper and lower valves, but more particularly from the latter, as the density of the atmosphere through which we were forcing our progress pressed so heavily on the valve at the top of the balloon as to admit of comparatively but a small escape by the aperture. At this juncture, had it not been for the application to our mouths of two pipes leading into an air bag with which we had furnished ourselves previous to starting, we must within a minute have been suffocated, and so but by different means, have shared the melancholy fate of our friend. This bag was formed of silk, sufficiently capacious to contain 100 gallons of atmospheric air. Prior to our ascent the bag was inflated, with the assistance of a pair of bellows, with 50 gallons of air, so allowing for any expansion which might be produced in the upper regions. Into one end of this bag were introduced two flexible tubes, and the moment we felt ourselves to be going up, in the manner just described, Mr. Spencer, as well as myself, placed either of them in our mouths. By this simple contrivance we preserved ourselves from instantaneous suffocation, a result which must have ensued from the apparently endless volume of gas with which the car was enveloped The gas, notwithstanding all our precautions, from the violence of its operation on the human frame, almost immediately deprived us of sight, and we were both, as far as our visionary powers were concerned, in a state of total darkness for four or five minutes.

"As soon as we had partially regained the use of our eyes, and had somewhat recovered from the effects of the awful scene into which, from the circumstances, we had been plunged, our first attention was directed to the barometer. I soon discovered that my powers had not sufficiently returned to enable me to see the mercury, but Mr. Spencer found that it stood at 13 20, giving an elevation of 23.384 feet, or about four miles and a quarter. I do not conceive, from the length of time I had been liberating the gas, that this was anything like our greatest altitude, for we were evidently effecting a rapid descent."

I have confined my observations on "this new world," to what can be experienced in the immediate vicinity of London. I have not spoken of isolated "talismanic" experiments trying the greatest velocity of locomotive engines in long distances; nor have I spoken of the magic of sweeping rapidly out of smoky London by the railway, to view the

"wild waves play"

on the Brighton shore! nor have I said a word of Atlantic steaming.

So much for England; and now, with respect to my own country, Ireland,—my "own loved island of sorrow," Ireland. I have strong reason to hope, that Lord Rosse's giant speculum, cast by him at Oxmantown Castle, will be indeed a "Talisman," a celestial Talisman, bearing that

"Throne of light"

of "the spirit," the human eye, in soaring ethereal flight through the empyræan, the blue serene, the hyaline of heaven!

Oh! how sublimely solemn will it be in

"The deep blue noon of night, lit by an orb,
"That looks a spirit, or a spirit's world,"

to hold in contemplation communion with nature, and "the Abyss of space," while using that wondrous Telescope!

"What a piece of work is man! how noble in reason! how infinite in faculties! in form and moving how express and admirable! in action how like an angel! in apprehension how like a God!"

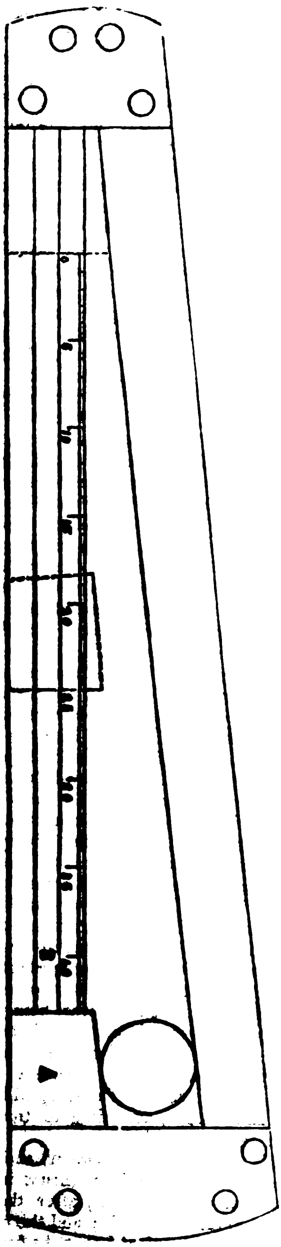
I am, my dear friend, as you well know, ever most truly yours,

Thomas Steele.

WIRE-GAUGES.

Sir,—The suggestion of your correspondent "K. H.," at page 520 of the last volume of your Magazine, relative to standard wire-gauges, is at once novel and simple, but by no means ensures that accuracy which it aims at. It should be recollected that the lines forming the sides of the gauge are not tangent to the diameter of the circle intercepted, but to a chord, and that varying with the angle

which those sides form with one another.



The difficulty, therefore, lies in distinguishing where that chord is situated, which is the index to the scale: that it cannot accurately be distinguished by the eye, (particularly in large diameters,) is certain. In the common wire-gauges, the *diameter* of the wire is measured, because the sides are parallel; but, as the principle of "K. H.'s" gauge is much too valuable to be lost, I would suggest an improvement which unites the principles of both, a sketch of which is annexed. It will readily be seen, that it differs from "K. H.'s" only in the sliding-piece A, which runs, by means of a small block with screws, in the slot B, with its inner edge always parallel to the opposite side of the gauge. Either end of the slider being made the index, a scale is formed with great facility, and the parallel sides intercepting the wire at its diameter, the objection to "K. H.'s" plan is at once obviated. I have shown the slides in these positions —at ½-inch, ¼-inch, and zero. A modification of this construction might form an exceedingly accurate calliper.

R. H.

EXPLOSIVE EFFECTS OF MIXTURES OF GUNPOWDER AND AIR.

Sir,—My attention being directed a few days since by a friend to a communication in your Magazine of December 17, 1842, entitled "Experiments on the Explosive Effects of Certain Mixtures of Gunpowder and Air: By Charles Thornton Coathupe, Esq.," I find the project on perusal to be substantially similar in effect to one suggested by me in the year 1841, and submitted to the notice of the Hon. the Board of Ordnance, by letter, dated March 17, 1842, and which, on being referred to the select committee, April 7th, produced the following report.

(Copy)

Office of Ordnance, April 13, 1842.

Sir,—I am directed by the Master General to acquaint you that he has received the Report of the Select Committee of Artillery Officers at Woolwich, upon your proposed "Mode of increasing Range and diminishing Recoil in Fire-arms," by which Report it appears that experiments at different times have proved that, *though the recoil is diminished when the ball is not in contact*

with the charge of the piece, the range is gradually decreased in proportion to the intervening distance; and that the Committee perceive nothing in the construction you propose that can have a tendency to produce a different result.

I am, Sir,
Your obedient servant,
(Signed) F. W. TRENCH.
R. J. Wilson, Esq.

Now, Sir, it is an admitted fact in the above report that the intervention of air between the ball and powder tends to diminish the recoil, (a point not seemingly noticed by your correspondent,) though the increase of range is therein denied. From the experiments made by me at the time, I submit the following average:—

Recoil by close contact . .	·112
,, intervention of air	·75
Range by close contact . .	·623
,, intervention of air	·755

The mode of construction proposed by me consisted in a shoulder being presented at the junction of the breech with the barrel, preventing the approach of the ball (within the best determined distance) to the charge; your correspondent having arrived at the same conclusion as myself respecting range. You will doubtless deem the subject worthy a notice and consideration, which may at once determine the value of the important advantages at present pending a strict investigation.

I am, Sir,
Your obedient servant,
RICHARD J. WILSON.

48, Old Broad-street, City.
January 31, 1843.

THE DAGUERREOTYPE PATENT.

In the course of a very interesting and instructive article on photogenic drawing, or drawing by the agency of light, in the last Number of the *Edinburgh Review*,* the French discovery of the daguerreotype, and its introduction into England, are thus adverted to.

"From the homage which we have cheerfully paid to the liberality of French philosophers and legislators, we could have desired to make no deduction; but there has been an *omission* in the transaction with M. Daguerre, which affects all nations, and which we would almost venture to request M. Arago still to supply. It is evident, from the whole tenor of the two Reports to the Chambers, that France purchased Daguerre's invention *for the benefit of all nations*, and not exclusively for the French people. It would be an insult to the two distinguished Reporters, and, indeed, to all parties concerned, to suppose that they had any other object in view. M. Arago emphatically says, 'This discovery France has adopted; from the first moment she has cherished a pride in liberally bestowing it—A GIFT TO THE WHOLE WORLD!' And M. Duchatel, the Minister of the Interior, on presenting the bill to the Chambers, distinctly declares, as an argument for a public reward, *that Daguerre's invention does not admit of being secured by patent*. So soon as it becomes known, every one may avail himself of its advantages. The most unskilful will produce designs with the same exactness as the most accomplished artist. Of necessity, then, this process must belong to all, or remain unknown.'

"The Daguerrian Bill had scarcely passed the legislature, when, 'on or about the 15th July, 1839, *a certain foreigner residing in France* instructed Mr. Miles Berry, a patent agent in London, immediately to petition her Majesty to grant her Royal Letters Patent for the exclusive use of the same within these kingdoms;' and, in consequence of these instructions, Mr. Miles Berry 'did apply for such letters patent; and her Majesty's solicitor-general, (Sir Thomas Wilde,) after hearing *all parties who opposed the same*, was pleased, on or about the 2nd of August, now last past, to issue his report to the Crown *in favour of the patent being granted;* and it consequently passed the great seal in the usual course, being sealed on the day above named, *which is* SOME DAYS PRIOR to the date of the exposition of the said invention or discovery to the French government at Paris, by MM. Daguerre and Niepoe, according to the terms of their agreement.''

"This remarkable statement, the object of which is very palpable, is thrust into the specification of the patent, after the usual preamble to all such deeds; and the patentee states, with great *naiveté*, that *he believes* it to be the invention or discovery of Messrs. Louis Jacques Maude Daguerre, and Joseph

* We are glad to observe that Mr. Spencer's claims to the invention of Electrotype, so long most shamefully slighted in the higher scientific circles of his native country, have the sanction of the able author of this article. In speaking of "the Electrotype, or Galvano-plastic Art," he mentions it as having been "*discovered by Mr. Spencer and Mr. Jacobi.*" Mr. Smee, whose study it seems to be to follow in the wake of authority, may be expected to profit by this hint in his next edition.

Isidore Niepce, junior, both of the kingdom of France; from whom the French government have purchased the invention, FOR THE BENEFIT OF THAT COUNTRY!

"The purpose of the preceding statement is obviously to create a belief, that M. Daguerre was not the foreigner who instructed the patent agent to petition her Majesty, and that he had transferred the benefit of his invention only to his own country. It is not our desire to investigate this part of the transaction any further: but we are bound to say, that the solicitor-general of England would have done better, to advise her Majesty not to withhold from *her subjects* that very invention which the King of the French had purchased for the benefit, not only of *his own people*, but of *all nations*. The patent cannot stand a moment's examination, and we would exhort the interested parties to apply for a writ of *scire facias*, for its immediate repeal."

The reproach cast on Sir Thomas Wilde for passing this patent is as groundless, as the advice given to apply for its repeal is foolish. When Sir Thomas Wilde reported in favour of the English patent, the secret of the process had not been published, either in France or England; and though a national grant to the inventor had been *proposed* in the French Chambers, on condition of the process being made free to all nations, that proposition had not then acquired the force of a law, which could be given in evidence before any foreign tribunal. Although *proposed*, the grant might have been *rejected*. Besides, even supposing the English patent had not been applied for till after the completion, by every legal formality, of M. Daguerre's bargain with the French legislature and government, we are not aware of the existence of any provision for such a case in the English law of patents. All that is required to be established, in the case of an application for an English patent for a foreign invention, (apart from its utility,) is, that it has not been before known or practised in this country; and that such was the case with respect to the Daguerreotype, is admitted on all hands. If the French chambers or government really desired to make good their intended gift to all nations, what they should have done was, to have had it simultaneously published in the languages of all nations, France included; and if they meant that Daguerre and Niepce should only receive the 10,000 francs in the event of the whole world being partâkers in the benefit of their invention, they should have made the payment dependent on *the event*. As it is, though the French government may possibly have something to say to Daguerre and Niepce, it is certain that nothing which passed between these parties can affect the validity of the English patent, which was granted in perfect conformity with the law of England, as it stood at the time, and still stands.

THE GAS-METER QUESTION.

We have received a letter from Mr. Flower, on our review of his pamphlet, which we feel it incumbent upon us, under the peculiar circumstances stated in it, to lay before our readers; though such replies upon critics are of acknowledged inconvenience, and there is nothing in the present one, so far as regards the principal subject matter, or the writer's manner of treating it, to entitle it to exemption from the ordinary rule. The circumstances we allude to are these. Mr. Flower states that he sent us "second and third editions, *together*," of his pamphlet; our review was of the *second* only; and Mr. Flower concludes that it could only arise from deliberate design, tinctured with a considerable want of "common honesty," that the third edition, which contains many corrections and emendations of the second, was not that reviewed. Now, this is a very grave charge, which it would cover us with shame not to be able on the instant utterly to refute. It is true that Mr. Flower did send us two pamphlets "together;" but whether they were second and third editions we cannot, from any observation or knowledge of our own, bear testimony. Our impression at the moment of receiving them was, that the author had sent us two copies of the same pamphlet—as is not uncommon where extracts are expected to be made—and, without staying to read their titles, or look into them, we made a present of one of the copies to a friend who was with us at the time, which copy, so given away, must (if Mr.

Flower's statement is correct, which we see no reason to doubt) have been the *third* edition. Most certainly, however, we had no idea that there was any *third* edition in the case, when we sat down to criticise Mr. Flower's labours; we thought the second edition, which was that before us, the latest and best; and no one, who will consider for a moment how brief any advantage to be achieved by overlooking the third edition must of necessity be, and how certain it was to be followed by speedy exposure and disgrace, can reasonably suppose the facts to be otherwise than as we now state them to be. But, as it does so happen, that Mr. Flower has been thus judged of by his second edition, instead of by his third and more improved edition, it is only fair that we should allow him an opportunity of pointing out the differences between them.

One word, however, as to our own position in regard to the gas-meter question, before we hand Mr. Flower's letter to the compositor. Mr. Flower charges us with the "kind solicitude of waiting upon public companies when they happen to be attacked," and acting in this matter as "the *employed* panegyrists of the companies." Contemptible inventions, both. We never waited on any public company under such circumstances, nor any other person for us, with our authority, privity, or consent; and we never have had the slightest communication of any sort with the gas companies, or any of them, on the subject of Mr. Flower's attacks.

Now, then, for Mr. Flower's letter; on which, after our readers have perused it, we shall have to trouble them with some further remarks:—

"*To the Editor of the Mechanics' Magazine.*

"Sir,—You are at perfect liberty to ascribe what motives you please to me for my exposé of the unfairness of gas-meters. Knowing your kind solicitude of waiting upon public companies when they happen to be attacked, I might, if I condescended to such a paltry line of procedure, twit you on that score; but in a case of this kind we have to deal with facts, and not with motives.

"In my pamphlet I have stated, that the loss to the consumers of gas by the gas water meter, in all those cases which I had had an opportunity of investigating, varied from 8 to 30 per cent., and that statement I again reiterate. It is true that Mr. Jones, of the Adelaide Gallery, in his lectures on 'the fallacies of gas-meters,' has been a more fortunate Diogenes than I have been; that gentleman has found a water-meter honest within 2 per cent., but, at the same time, he has discovered that the imposition may be as great as 32 per cent. (Vide the "Morning Herald" Report of Mr. Jones's Lecture, Jan. 20, 1843.) Meters, therefore, have been found cheating the public through all the gradations of from 2 to 32 per cent. Any one may satisfy himself by ocular demonstration of this fact, by a visit to the Gallery, where the meters may be seen. Neither are these meters "the oldest and worst that can be found." On the contrary, they are "crack" specimens.

"My attention was first called to the fact of the unfairness of meters by detecting a meter that was cheating me. This led me to examine others; and the fraud that I found them committing was, as I have stated, from 8 to 30 per cent. Upon this I wrote my remarks; and, as I believe it is not usual to be very delicate with a thief we find picking our pocket, I expressed myself as I have done on the meter system; whether in good taste, or not, is open to criticism; but I utterly deny using the terms 'rogue,' or 'scoundrel;' they are not to be found in my publication.

"When I had written the body of my pamphlet, I heard, for the first time, of the dry meter, and with some trouble I found out the inventor of the best dry system, Mr. Defries. I called upon him, and mentioned that I intended to expose what I considered to be the frauds of the meter system, and requested that he would let me have one of his meters to test. This request he refused; and it is only justice to Mr. Defries to state the impression which his refusal had upon my mind, and which, I must confess, prejudiced me in his favour, namely, a desire of not bringing his meter in invidious contrast with those of his contemporaries. I saw, however, quite sufficient of Mr. Defries' meter to be satisfied that the principle of it —of doing away with water—was, as I have written, 'excellent;' and beyond this, more or less, under such circumstances, I could not say. And, because I give the fact as it occurred, you assume that I am actuated by sinister motives. Now, if *you* had been candid, you would have found that I was willing and delighted to afford praise, where I could, to other meter manufacturers, as well as Mr.

Defries; but, by a deliberate act of injustice to me, to extenuate the gas companies, whose interests you seem so tenderly alive to, you choose to shut your eyes to my evidence on that head, by taking the second edition of my production as the thread upon which to hang your remarks, when you ought, in common honesty, to have examined the third edition of it as well. This was any thing but correct in a reviewer, who finds 'the murder 's out;' or who indulges in the terms of 'hireling pamphleteer,' 'volunteer traducer,' &c. When my first edition made its appearance, I sent you a copy. You took no notice of it, and I was ready to believe that you were unwilling to give publicity to the charges on my mere *ipse dixit*. Subsequently, at the period when Mr. Jones's statements and *corroboration of my assertion* were, as they now are, agitating the public mind, I sent you my second and third editions *together*; and if you will examine the last edition, you will find that I give the highest praise to Milne's Scotch *water-meters*. I warmly and strongly commend them. Here are the words:—

"'One of these meters is certified by the manager and seal of the Edinburgh Gas-light Company, as having been in constant use for the last eighteen years. The other is Messrs. Milne's Improved Patent Gas-meter. I have tested these meters, and both are slow—namely, they give more gas than they register, and are alike creditable to the liberality of the Company which allows them to be used, and advantageous to the consumer. Their construction is such, that *when they are filled with as much water as they will hold*, (which would occasion a loss of about thirty per cent. in many English meters,) they give an excess of measure, which excess increases as the water evaporates, until the lights betray that it requires replenishing. The notation of the dials on the Improved Patent Gas-meter is singularly interesting and perfect, and is well worthy of imitation by all meter-makers. Not only is every foot of gas plainly marked as it is consumed, but, by an ingenious and clever introduction of an extra hand on the dial measuring each foot, every hundredth part of a foot is distinctly perceived as it is burned; and, with very little attention, the thousandth part of a foot is discernible. This extra hand, of course, travels very fast, and by it the most sensible motion of the meter is detected, and the minutest defect in the fittings indicated. The principle of these meters is such, that they can never operate to the disadvantage of the consumer, but the contrary.'

"Neither do I overlook Mr. Botten's merits. Here is the passage:—

"'From this censure, however, Mr. Botten's meters must be honourably acquitted. I have found them to be, generally, much nearer the mark for correctness than their compeers, and, perhaps, if they were not *obliged* to be under the sinister influence of the Companies, they would be as accurate as it is possible for water-meters to be; but it must not be forgotten that exactness can never, under any circumstances, be obtained by these machines, the constant variation of pressure to which gas is subject continually altering the level of the water, and precluding uniformity.'

"You say that I regard the water-meter as radically false in principle. *I do* in some degree, and I am ready to maintain it, but I suppose your space will not allow me to enter upon the subject. I however maintain this—*That the water-meter differs in registration by variations of pressure; that is to say, the consumer gets more gas in the cubic foot* registered at one time than another.*

"At a high pressure he gets an approximation of his quantity of gas, *but at a low pressure*, owing to the sinuosities which the gas has to pass through in its way to the cylinder or drum, it becomes so enfeebled that the measuring chambers in it are not properly filled, but which a high pressure overcomes.

"You may perhaps ask why I did not speak approvingly of Messrs. Botten and Milne, in my second edition? I frankly admit that the subject has grown in importance since I took it up, and that my attention has been more specially directed to the subject, which, at the time I went to press with my second edition, was not the case. If I have praised Mr. Defries's meter, and it is worthy of every praise, you yourself allowing that it is likely to supersede the other system, I did it because it was in some measure forced upon me. I was constantly called upon by letter, and that by country gas companies, too, to know if I had tested the dry meter, and I was obliged to inform Mr. Defries that if he would not let me have a meter I would 'get one by hook or by crook,' and that if I fell upon his first patent, which is much inferior to his second, he must take the consequences of an imperfect instead of a perfect machine being described, and under such features I obtained one.

"You say, that 'Every one, who knows anything of the history of gas-lighting, knows that the plan of measuring by meters the gas supplied to customers, did not originate with

* "The cubic foot as indicated by the register—the nominal and not the real foot of 1728 inches."

the companies, and was not assented to by them till after a good deal of opposition and delay on their parts."

"This is a part of the question I have not entered into. Things, however, have changed since then.

'Qui color albus erat, nunc est contrarius albo.'

"The time was when insurance offices refused to insure premises where gas-light was used. Every one will allow now, that not half the number of fires happen since the introduction of gas. But it is not against the use of meters that I complain, but of the abuse by them. I know, however, that there are many who would gladly have their gas by contract who are compelled to burn by meter. For the truth of this I refer to the fruiterers of Covent-Garden market, and others. It is well known that the gas companies are most partial and arbitrary in their contracts, and regulations of burning by meter, and *vice versa*. The fruiterers that I have alluded to in Covent-Garden are obliged to burn by meter, while Drury Lane Theatre, Covent-Garden Theatre, the *Morning Chronicle* Office, &c, places where it is impossible to have fixed periods of lighting, are allowed to burn by contract.

"I have now given my reasons for the appearance of my pamphlet.—As one of the public, who has no interest to serve, who has no connexion with gas companies, nor gas-meter makers, and who is neither a hireling pamphleteer, nor a volunteer traducer—

'The very head and front of my offending
Hath this extent, no more.'

"THE AUTHOR OF THE PAMPHLET ON THE UNFAIRNESS OF GAS-METERS.

"5, New Bridge-street, Blackfriars,
Jan. 30, 1843."

"(Note.)—In reading over this copy I am forcibly reminded of a remark which did not occur to me while I was writing it, namely, that if a certain class have need of good memories, it is equally essential for some reviewers to have the same quality. In the first and second editions of the pamphlet I only complain of the water-meter not being made of sufficient capacity; *not a word is said regarding the principle of it*. It was only, as I have stated, when I was taking the third edition through the press, that my attention was specially directed to the subject, and THERE it is, as you learn, that 'I regard the water-meter as radically false in principle.'

'Now, infidel, I have thee on the hip!'

"Which of us, now, writes in 'the most uncandid spirit, and with very sinister views?' &c., &c.

"The murder *is* indeed out. What a blundering panegyrist have the companies employed!"

Mr. Flower, it will be seen, lacks not words, nor of those the least polite, but what does he prove? Just this—the perfect truth of all we said as to the unfairness of his course of proceeding, and his utter incapacity to pass a judgment worth any thing on the matter which he has ventured to meddle with. We never saw a clearer case of the *invitâ Minervâ*.

Notwithstanding he assures us in his second edition, that "it was not without *due investigation*" that the statements in the first were put forth, he now admits that neither in his first nor in his second editions, did he take any notice of Milne's *improved* meter, of which there are thousands and tens of thousands in use, and the principle of which is such "that they can never operate to the disadvantage of the consumer, but the contrary." He admits, also, that as little did he take any notice, either in his first or in his second editions, of Botten's *improved* meter, of which great numbers are also in use, and which he now acknowledges "would be as accurate as it is possible for water meters to be, if they were not obliged to be under the *sinister* influence of the companies"—for which "if" there is no foundation whatever, except in his own imagination.* And he says further, that, "when I had written the body of the pamphlet, I heard, for *the first time*, of the dry meter."

Now, either Mr. Flower did know nothing of Milne's and Botten's *improved* water meters, and nothing of the existence of such things as *dry meters*, at the time he commenced his crusade against the Gas Companies; or, knowing all about them, he chose to suppress all mention of them. He may take either horn of the dilemma he likes best. If he knew nothing of them, (which is the alternative, we presume, that he will prefer,) then does he stand self-convicted of a degree

* This is the meter alluded to by Mr. Flower as having been found by the other Diogenes in the tub, as "honest within 2 per cent." Subsequent experiments, of which the reader will find an account in another part of our present Number, have shown it to be honest within a half per cent., and in one case honest to the "greatest nicety."

of ignorance of gas-meters and gas-lighting (his "due investigation" notwithstanding) which makes his offer to enlighten the public on the subject supremely ridiculous; and then, also, our words are made good, that when he put forth his charge against the companies of patronising the water meters *because* they knew them to measure falsely, he had never troubled himself to enquire "how they had been improved, or how they might be improved, or how the companies had exerted themselves to improve them." If, on the other hand, he did know all about them, then have we been wrong only in so far as we put the least uncharitable interpretation on his conduct; for, wilfully to suppress all mention of the *improved* meters because they would have overturned his theory of their incurable fallacy, could arise only from rank knavery.

But Mr. Flower now alleges that in the first and second editions of the pamphlet, "*not a word is said regarding the principle* of the water meter." We begin to suspect shrewdly that Mr. Flower does not at times *know what he says.* In the preface to his *second* edition are these words, "If any one will patiently study the nature of the gas-meter, as here faithfully described, the fact that the PRINCIPLE of it is objectionable, will be so obvious that, perhaps, the silence (of the companies) ought not to be wondered at."

Neither, he says, did he ever use the terms "rogue and scoundrel." (We did not say he had used these particular words.) Oh, no! He only accused them of "imposture," "tricking and duping," "dishonest profit," &c. And now, by way of *softening* down his language to the tone of decent society, he *only* charges them with "*cheating* the public through all the gradations of from 2 to 32 per cent.!"

All intention of promoting the introduction of Mr. Defries's gas-meter, by raising the present outcry against the water meters, Mr. Flower of course very stoutly disclaims. We shall briefly give our reasons for the impressions we entertain on this head, and then leave our readers to judge for themselves.

1. For a year past and more, Defries's dry gas-meter has, in one shape or other, been kept most industriously before the (London) public eye; cried up at learned societies, paragraphed in newspapers, and proclaimed in the streets by advertising perambulators. We should have thought it difficult to find a man, woman, or child, in all London, who had not, by the dog days of 1842, become familiar with the words "Defries's Gas-meter." And when, therefore, Mr. Henry Flower, of 5, New Bridge-street, Blackfriars, tells us it was not till *after* he had written his pamphlet against the water meter (June, 1842), that "he heard *for the first time* of the *dry* meter," we feel irresistibly compelled to say, with the laconic Burchell, "Fudge!"

2. After Mr. Flower had thus heard of the dry meter, he says, "I with some trouble found out the inventor of the best dry system, Mr. Defries." "*Trouble*" to find out one of the best advertised men in all London, to whose *locus in quo* Piggot or Kelly could in an instant have directed him! But *no* "trouble" whatever in discovering Mr. Defries to be "the inventor of *the best dry system;*" *that* he knew before even seeing him, or testing his meter! Again we say, "Fudge!"

3. We are told that Mr. Defries refused at first to let Mr. Flower have one of his meters to test, from "desire of not bringing his meter in invidious contrast with those of his contemporaries." Modest Mr. Defries! whose dislike of "invidious contrast" displays itself in society lionizing, paper puffs, and itinerant show-boards! We say once more, and most emphatically, "Fudge!"

4. Mr. Flower says, "If I have praised Mr. Defries's meter, and it is worthy of all praise, *you yourself allowing that it is likely to supersede the other system,* I did it because it was in some measure *forced* upon me." We did say that we thought the dry meter *system* was likely to supersede the other; but we passed no opinion whatever upon Mr. Defries's meter; and none but a devoted partizan, *seeing with Mr. Defries's eyes,* would have attempted to fasten such an opinion upon us.

5. Mr. Flower's abuse of the water meter system would have been *without an object* (unless it were a return to the old contract system, which he does not advocate), but for the *Defries dry meter sequel.*

And 6. The way in which this object has been gradually unveiled is precisely that which experience has told us is common to all who seek by "stealthy steps" to gain the 'vantage ground of others. First, there is the brief hint, just before parting, that there is such a thing in existence, which *may* be worth enquiring about. Then there is the hint acted upon, and the discovery made (by instinct!) that it *is* the very best thing of the kind. Next we have the ingenious inventor (so modest withal!) dragged, in spite of himself, from the obscurity he would have greatly preferred, to be crowned with laurels (in *flower*). And, last of all, we have the purpose entertained from the first thus openly avowed (*third* edition):—

"But I am asked, what is the remedy for this grievance? My object is merely to instruct the reader; and by laying before him *a description of a recent invention, that of the dry gas-meter,* I hope I shall accomplish that *object, and answer this enquiry.*"

Why then, it may be further asked, not say so at first? Why wait till the third edition to make your *object* known? If Mr. Flower answers truly, he will say, "Because if I had done so, the public would have seen at once that my pamphlet was a mere advertising puff; and would have treated it with no more respect than they are accustomed to bestow on such *disinterested* effusions."

Advertising puffs are, of course, not fit subjects for criticism; but we cannot refrain, before concluding, from giving a specimen from the one before us, because of the direct bearing which it has on Mr. Flower's qualifications to bestow either praise or censure in a case of this sort.

"An important advantage attending the dry gas-meter is that its performance *is not affected by the temperature of the weather;* and as there is neither evaporation nor condensation with it, all the fittings remain intact."—3rd edition, page 26.

Corollary,—Gases are not expanded by heat, nor condensed by cold! A new truth in physical science, first discovered, Anno Domini 1842, by Henry Flower, of 5, New Bridge-street, Blackfriars.

For some useful information on the actual merits of the water and dry meter systems, we beg to refer to the Report, which will be found in another part of our present Number, of the proceedings at the Adelaide Gallery.

BALLOONING—CONTROLLING THE DIRECT EFFECT OF THE WIND—MR. CHARLES GREEN.

We are informed that the celebrated aëreal navigator and inventor, Mr. Charles Green, is sanguine in the expectation that his invention of the "*guide-line*" will afford him not only, as it does at present, a power of ascertaining the direction in which his balloon is moving, together with the various other effects, the result of that invention; but that it will also afford him, to a certain extent, and within certain limits, a power of modifying the direct effect of the current of air on the machine, instead of having it, as at present, propelled inevitably in the direction of the wind. Mr. Green intends, with becoming caution, to test his theory by rigorous experiment, before making any formal announcement.

WORTH'S PATENT ROTARY PUMP.

Fig. 1 (next page) is a representation of this pump, in its complete state, as fixed for action. The body of the pump, or working box, consists of a circular case, an inside view of one of the discs or plates of which is given in fig. 3. The parts *c*, *d*, and *e* are raised upon the plate. The two plates are neatly fitted to each other, with the open face of the one inserted into that of the other. The revolving disc, fig. 2, (with its two valves *f* and *g*,) is placed between them, after which they are then soldered up: *a* and *b* are two pipes, *b* being the suction, and *a* the ejection pipe. On turning the handle, the revolving disc, fig. 2, is carried round, and, by the action of the crosses *h h* upon the raised parts *c* and *i*, the valves *f* and *g* are alternately opened and closed, carrying the water contained in the space *k k* before them, which quantity of water is ejected through the pipe *a*, which may

Fig. 1.

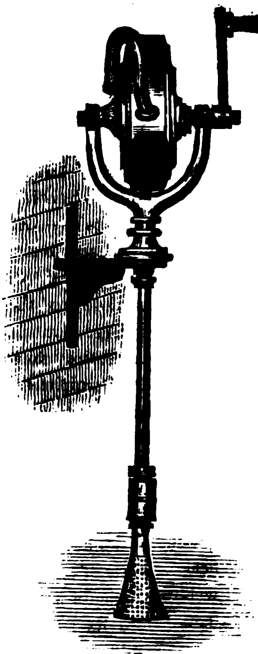


Fig. 2.

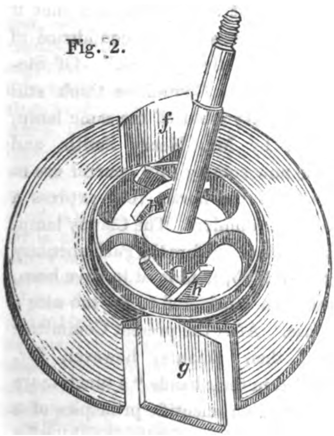
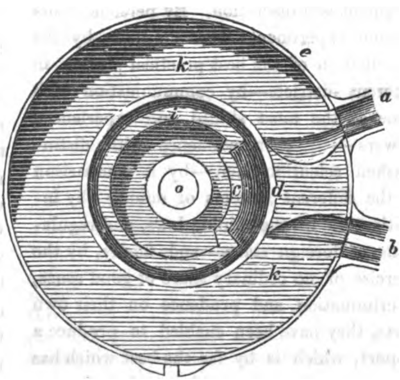


Fig. 3.



be of any length required to force up the water to any height under 50 feet.

The patentee states, that a pump of this construction, only seven inches diameter and two and a quarter inches wide, is capable of raising thirty gallons per minute; and that, when properly put up, it will last for years without repairs. We see no reason to doubt that it will perform what is reported of it, ***for a time;*** but we think it idle to expect that mechanism of such nicety, ingenious though it be, and so much liable to friction, will "last for years without repairs." It is not possible but that repairs must be very frequently required; and when required, they will unquestionably be a source of great trouble and annoyance.

ACCIDENTS IN COAL-MINES—THE SOUTH SHIELDS REPORT.*

After the memorable accident at St. Hilda on the 28th of June, 1839, when fifty-two lives were lost, a public meeting was held of the inhabitants of the adjacent town of South Shields, for the purpose of adopting some means to diminish the frequency of such disastrous occurrences, when a Committee of Investigation was appointed, consisting of the gentlemen named below.† The labours of this Committee, during the three years which have since elapsed, to come to fair and just conclusions on the many difficult and important points involved in their enquiry, have been arduous and unceasing. To avoid, on the one hand, being betrayed by feelings of humanity into recommendations of measures, of so extreme a character as to be ultimately injurious to the very individuals intended to be benfited; and to take care, on the other, that the importance to the public of a cheap, abundant, and enduring supply of coal should not be allowed to weigh too heavily in the scale, against the safety and welfare of those to whom that supply gives employment, was by no means an easy task; but it is one which, we are happy to say, the Committee have performed with admirable judgment and discretion. By personal visits to, and experiments in the mines—by the examination of the best practical pitmen, in different districts—by communication with some of the most skilful and experienced viewers — by correspondence with distinguished scientific men — by a comparison of the different systems of mining—by investigation of the mining laws, and regulations of foreign states—and, finally, by the exercise of no ordinary share of good sense, discrimination, and prudence on their own parts, they have been enabled to produce a Report, which is by far the best which has yet appeared on the subject. It is incomparably superior to the Parliamentary Report of 1835; and better, even, than the Belgian Report, which we had lately occasion to notice with so much approbation.

The branch of the enquiry to which the Committee first apply themselves is that of "Safety Lamps." The Davy — Stephenson's — Smith's — Clanny's — Upton and Roberts's — Lemielle's — and Mueseler's— are successively and fully treated of. The Davy, long considered so infallible an antidote to the fire-damp, is here pronounced, on the clearest evidence, to be an entire failure. "Considering," say the Committee, "that the Davy lamp has been found by *experiment*, and *in practice, to explode the external gas*, by the passage of the flame through the gauze, and that a dangerous contingency is produced when the lamp is hot, to which it is peculiarly liable, no doubt can remain *that it has been the cause* of some of the hitherto unaccountable accidents which have occurred; that therefore its employment is far more *uncertain* and *dangerous* than the friends of humanity and science at first anticipated, and that it has too long possessed the confidence of miners in its protective powers." Of Stephenson's lamp the Committee think still less than the Davy; but of the same lamp, as improved by Mr. Henry Smith, and stated to be now coming into general use in the collieries of the north, they express a more favourable opinion. The Clanny lamp, which was produced before the Parliamentary Committee of 1835, is allowed to have been, what it was then considered to be, too nice a thing for use. After the present Committee commenced their labours, however, Dr. Clanny placed in their hands "a much more ingenious lamp, on scientific principles of a higher order, and practically much safer than his last lamp, or the common Davy;" and of this new lamp we have the following description:—

Dr. Clanny's Improved Lamp.

"In a paper read to the Committee, 17th August, 1839, the Doctor assigns the following as part of the reasons that influenced its suggestion and construction.

* The Report of the South Shields Committee, appointed to Investigate the Causes of Accidents in Coal-mines. 79 pp. folio. With Plans and Appendix. Longman and Co.

† Robert Ingham, Esq., President; Thomas M. Winterbottom, M.D.; Richard Shortridge, Esq., J.P.; James Wardle Roxby, Esq., J.P.; John Clay, Esq.; Errington Bell, Esq.; Robert Walter Swinburne, Esq.; William K. Eddowes, Esq.; Anthony Harrison, Esq.; and James Mather and Thomas Salmon, Esqrs., Honorary Secretaries.

The diffusion of heat through the gases is effected in a great measure by the motion of their particles among each other. We are indebted to Dr. Priestley, Dr. Dalton, and Professor Graham, of London, for much valuable information in respect to the diffusion of gases; and from the valuable experiments of the last-mentioned philosopher, we are assured that the same quantity of different gases escapes in times which are exceedingly unequal, but have a relation to the specific gravity of the gas. The light gases diffuse most rapidly: thus hydrogen escapes five times quicker than carbonic acid, which is 22 times heavier than that gas. In the case of an intimate mixture of two gases, the most diffusive gas separates from the other, and leaves the receiver in the greatest proportion. Volatile bodies rise into the atmospheric air, as well as into a vacuum, and obviously according to the law by which gases diffuse through each other. Heat is conducted by air in the same manner that it is conducted by water and other fluids, namely, at low temperatures by communication only, and at high temperatures by the effect of the diminution which the weight of heated molecules or particles undergoes, and by the motion in ascent thereby imparted. It is a law deduced from the physical properties of gaseous bodies, that the velocities of gases, flowing under like circumstances into a vacuum, is inversely as the square roots of their densities, which is precisely the same law that regulates their flow into each other. Holding these facts in view, I constructed my new safety lamp, and by experiment I found that, just within the glass, and opposite the flame, the temperature was 108° on Fahrenheit's scale; and between the top of the rim and of the wire gauze cylinder the thermometer indicated 302° of temperature; I need scarcely remark that in all lamps the air is constantly changing, and that in this safety lamp the *operation of the high temperature causes the expansion and diffusion of fire-damps, or of any other inflammable gas which may surround it; whilst, at the same time, a very small quantity of inflammable gas will find its way to the flame of the oil lamp, but will be diffused into the atmosphere.*'

"To produce this result Dr. Clanny constructed his new lamp with an impervious metal shield, having glass and lenses in its sides, only open at the highest part of the gauze cylinder for about 1½ inch from the top, and surrounding the lamp entirely to the oil vessel: the shield being in diameter fully ½ inch more than the lamp. There is, consequently, no admission or egress of air but *only over the top of the shield*, at the highest part of the lamp. The Committee experimented at different times in the mine with this new construction of Dr. Clanny. From the first lamps having had window glass in their sides, several accidents occurred, rendering them simple Davy lamps; the lamp with the lens burnt well, but was deficient in light, owing to the rest of the shield being entirely metal. In an experiment at Wallsend by the Committee, accompanied by Mr. Buddle, in a strong air course, the Davy lamp, and Upton and Roberts's, were extinguished by the force of the current, while this lamp of Clanny retained, from its protecting shield, its light unaffected. When these three lamps were tried at the same pit, in a feeder of gas, Upton and Roberts's first exploded itself out; then the Davy, with a slight audible explosion; while this Clanny lamp did not appear much affected by the gas, although the light was so imperfect as to show only a glimmer through the lens.

"In several trials it continued to operate in a similar manner; but the light was invariably so small as to be inapplicable to the purposes of practical mining.

"Dr. Clanny has, however, since the above period, made an alteration on that point which obviates entirely the obstruction of light by the metal shield; he has substituted for that part of it opposite the flame a thick globular shield of glass, which reflects the light in a very perfect manner, the metal shield being continued from it upwards, as before explained, nearly to the top of the gauze cylinder; receiving its supply of air to support combustion *exclusively from above*, which, at the same part, emits the decomposed air. At first sight it appears singular that the entire of the interior within the shield should not be filled with nitrogen, carbonic acid gas, &c., and the light thereby extinguished, which invariably takes place when an external shield is made of so small a diameter as closely to envelop the gauze cylinder. It is thus demonstrated, that in a lamp of this construction the air for the supply of flame passes down between the cylinder and shield, and returns up the middle of the interior of the lamp, and is thrown off at its highest part on the principle laid down by Dr. Clanny; and the air having to descend through a heated medium excludes much of the light explosive gases both from their specific gravity and their increased diffusibility from the operation of heat.

"This perhaps may account, in some degree, for the steadiness and brightness with which, in a moderately inflammable atmosphere, as well as in a current, this lamp continues to burn.

"There is a just objection to the risk of fracture to the glass, which is external and

unprotected, and which, though of great strength, an accidental blow, or a drop of water when heated, might in an instant effect; but this, however, would then only render it a Davy lamp. A lamp which the Doctor has placed before the Committee on this principle, but with a naked projecting globe of strong glass, without any external wire gauze, is perfectly inadmissible for the reason just assigned,—the facility of fracture of the glass. Another objection made by miners to its employment is its great weight as compared with the Davy; this difficulty, it is feared, would not be easily surmounted by the wastemen, who have to travel many hours a day through narrow passages generally in a bent posture, and often on hands and knees with their lamp in hand: and even to the common miner it is a matter of strong objection amounting to dislike, but which experience would doubtless overcome.

"The danger continues to exist, in some degree, in this as in other lamps, although to a greatly diminished extent,—that in a highly explosive atmosphere the upper part of the lamp becomes much heated, and thus tends to bring into operation the contingencies of explosion by olefiant, sulphuretted hydrogen, or hydrogen gas; and, therefore, though a vast improvement, neither is this most ingenious and scientific lamp the desideratum so much sought after—*in all points a perfect safety lamp;* yet in principle and operation it is infinitely superior to any the Committee have yet examined.

The lamp of Upton and Roberts, which, in the judgment of the Parliamentary Committee of 1835, left scarcely any thing to be desired, has great praise bestowed upon it, but with some serious qualifications.

Upton and Roberts's Lamp.

"The Committee in placing on record, which is necessary here, the description of Upton and Roberts's lamp, will take that forwarded by Mr. Upton himself. It consists of a cylinder or cage of wire gauze, as in the Davy lamp, 5½ inches high and 1½ diameter, over which, enveloping it externally, is a glass covering. The air is admitted through horizontal apertures immediately over the oil vessel, and then is passed through a double layer of horizontal gauze, two moveable disks, which forms the bottom of the lamp, in the centre of which the wick rises; the whole of the air being turned on the flame of the wick by means of a cone, the circumference of whose apex surrounds the lower part of the flame. The gauze top is doubled, as in the Davy, by a cap; and there is, in addition, a metal chimney 2½ inches high, 1¾ in its base, and contracting at its throat to 1¼ inch, with large perforations near the top to emit the smoke and decomposed air. This chimney screws down closely upon the external glass covering, which is 4½ inches high.

"When the lamp is lighted the air passes through the horizontal apertures, and then takes a direction at right angles upwards, through the double gauze bottom directed by the cone on the wick; and the air seems ruled in its admission to the lamp by the supply required to feed the flame. In an explosive atmosphere, by its restricted admission to the flame, it is nearly all consumed as it presents itself, and it is scarcely possible to fill the lamp with it: whatever escapes without passing the flame is so vitiated and rendered incapable of supporting combustion by the nitrogen and carbonic acid gases rising in the lamp, that no gas flame ever reaches high in the interior of the cylinder; if in a very fiery mixture slight explosions occur, and the light is speedily extinguished. Thus there is no cause to apprehend, under any circumstances, the possibility of over-heating the gauze top: the Committee have found it impossible to effect it in the most fiery mine, and there is no explosive mixture that can be made to pass the flame upwards, while the glass secures it against currents of air or of blowers; extinction by inflammable mixtures, and not explosion, being its principle.

"The chimney, by being contracted, bears a proportion for the exit of the air after combustion to the perforations, gauze, and cone, for its admittance; thus preventing a rush through the apertures below on the flame, which would either extinguish it or escape into the lamp unconsumed, and in an inflammable air burn to overheat the lamp. The contracted chimney also keeps an atmosphere of deoxygenated air, if it may be thus called, over the weakest part of the top of the lamp, doubly securing it from overheating.

"Whenever the Committee have tried this lamp in the fiery mines of the north, its delicacy was such that before the Davy lamp was much affected it usually exploded itself out: and this occurred to other lamps as well as that sent by Mr. Upton. It was impossible to fill it with flame: an indication and warning, it perpetually hinted danger.

"In a goaf of St. Hilda Pit, it is stated in the minutes of the Committee, that when tried,—'For an instant the flame burnt blue, extending up the interior nearly two inches, and then with a slight explosion extinguished itself:' this was repeated, and it almost instantly invariably did the same. In an experiment with lamps in Monkwearmouth Pit (the deepest in England,) 'it extinguished

itself even at a walking pace in the hand: the glass and light were smoky and dim. At Wallsend it was tried with other lamps in a feeder of gas, and could scarcely be brought into operation from its facility of extinction.[1] At Jarrow Pit, when tried in a strong blower of gas, it was the first extinguished; but such was the force that both the Davy lamp and the original Clanny's were also blown out. At Pensher Pit, on the Wear, the current of air in the furnace drift also extinguished it. Indeed, in every instance this sensitiveness, on exposure to the slightest breath or explosive mixture, regularly demonstrated itself.

"It is this very delicacy of operation which renders it with practical miners so objectionable for their daily employment in the mine. It obstructs instead of facilitating their object. A sudden dropping of the hand with a lamp puts out the light; the slightest increase of foul air bedims the glass, and then the flame gradually dies or explodes out. The horizontal gauze placed below the level of the oil wick, receives from the trimming or an accidental spark, little vesicles of oil which clog and impede the flow of air; the light then soon becomes smoky and dull, and in this case eventually dies out, or the lamp must be brought to a free part of the mine to be cleaned and re-arranged.

"The Committee have frequently seen it blown out by a current of air in the gallery, and it invariably required the nicest care to keep it burning for a few hours in the different parts and states of the mines. Even a breath through the bottom perforations would at once extinguish it.

"To ordinary workmen this difficulty is insurmountable. It would be impossible even to compel its adoption in the northern mines: the result on their produce would be seriously injurious. In the hands of careful men of science it is a perfect lamp for occasional experiments. Secure from any contingency that may arise, its glass may be accidentally broken and it resolves itself into a Davy lamp; nothing but a crushing blow will lay bare any chance of danger. But in the hands of the mere miner, intent upon his labour, and irritated from its imperfect and uncertain light, there is every probability that the most hazardous expedients would be had recourse to, and that it would become more dangerous than a common gauze lamp in his ill-judged attempts to increase or continue his light for his necessary operations."

The Lemeille and Mueseler are two Belgian lamps with which the Committee were obligingly furnished by M. Weyer, the Belgian ambassador. The first is altogether condemned, but the second, which was pronounced by the Belgian Commission as the best of all the lamps ever contrived, is also very favourably regarded by this Committee.

The Mueseler Lamp.

"This lamp stands about 10 inches high, including its oil vessel; and its external diameter is, from 5 inches upwards, about 3½ inches. This great diameter is owing to a sort of shield, of eight ribs of iron, placed edgeways, vertically covering a very strong glass, ¼ of an inch thick, formed like an ordinary drinking glass, without a bottom, which is 3½ inches high, and 1¾ internal diameter. This glass is placed around the flame of the lamp, excluding all air, except *over its top*, which is covered with wire gauze, but *without any other gauze internal or external*; it is thus a naked glass except the eight vertical ribs of iron, which are each an inch apart. Placed upon the glass, and as a continuation of it, is a wire gauze cylinder, 4½ inches high, and 1¾ internal diameter, having a brass top full of minute perforations. The glass and wire gauze, closely united, make a continued cylinder about 8 inches in height; having a piece of wire gauze stretched across the internal area at the junction of the two substances, over the top of the glass, as above stated. Through the centre of this piece of horizontal gauze there is a small metal chimney to convey from the flame of the lamp the smoke and deoxygenated air; it passes down to within an inch of the wick, is 4 inches high, about $\frac{7}{10}$ths in diameter below, and $\frac{4}{10}$ths above, and rises to discharge the smoke, &c., about half way into the interior of the wire gauze cylinder.

"The Committee have been thus particular in the description of the 'Mueseler lamp,' because the Belgic Commission consider its superiority undoubted over the Davy, Upton and Roberts's, and every other lamp hitherto invented: and that its principle is new, its safety perfect, and its light surpassing all others.

"When this lamp is set in operation, the air to supply the flame passes *from above downwards*: first through the gauze sides of the cylinder above, and then through the transverse gauze on the top of the glass; and when it has performed its office, it ascends through the chimney in the centre exactly over the wick.

"The effects appear to be similar to those in the improved Clanny lamp, described a few pages back, wherein the air enters at the upper part of the lamp. The air in the lamp is kept freer than in the Davy or other lamps; its current stronger, and its light better. It, however, more easily explodes itself out than the Clanny lamp when the

inflammable mixture is of considerable strength. The flame cannot pass by explosion, as, in addition to the almost impossibility of surcharging a lighted lamp of this description with gas, there is no egress but over the top of the glass through the transverse gauze, and then again through the sides of the gauze cylinder at right angles with it, thus completely guarding it against this danger. But the flame can scarcely long exist from a certain delicacy which the lamp possesses when immersed in an explosive mixture, for it speedily explodes itself out.

"On trials with the Mueseler lamp in the month of July, 1841, and since in one of our most fiery mines, the Committee found the light very good, unaffected with currents; and when placed in a recess of the "*broken*," in which much gas existed, it gave slight audible explosions, and immediately extinguished.

"The Belgic Commission thus speaks of this lamp:—'Elle a soutenu les épreuves de la manière la plus satisfaisante, et a été unanimement considerée comme réunissant, a un plus haut dégré que toutes celles essayées jusqu'ici, les conditions essentielles d'une bonne lampe de sureté. *La commission a vu un perfectionnement d'une grande portée dans la disposition qui consiste à faire arriver, par le haut, et non par le bas, l'air destiné à la combustion de la mèche*, et à combiner les choses, de telle sorte que, lorsque l'air contient une quantité de gaz inflammable capable de faire craindre une explosion, et par consequent d'activer momentanément la combustion outre mesure; le premier effet de cette activité extraordinaire soit d'alterer cette composition dangereuse de l'air entrant, en y mélant dans une proportion notable, une partie de gaz brulé; ce qui non-seulement rend impossible toute deflagration, mais contribue encore à la prompte extinction des parties en ignition.'*

"The principle so much approved of by the Commission, in the above extract, of supplying the wick of the Mueseler lamp by air from above and not from below, it is but justice to Dr. Clanny, and in accordance with truth, that this Committee repeat here, that, in a paper publicly read to them on the 17th of August, 1839, already examined, in which Dr. Clanny explained the construction of his new lamp, passing the air *downwards to the wick* from the summit of a shield nearly covering the entire gauze, was the principle on which it was based. It was tried by this Committee in the mines at the time, and published in the journals of the day, and M. Mueseler, according to the Belgic Committee, did not offer his lamp to their examination till they were about terminating their labours in August, 1840;* and the 18th of August, in that year, was the first time that the Commission experimented with it. Consequently Dr. Clanny possesses the undivided merit of the discovery and application of this principle, and had, upwards of a year, a published priority of it over its adoption and application by M. Mueseler.

"The Belgic Commission, after trying the Mueseler lamp with various explosive mixtures, terminate their report of it thus:—'Il est aisé de juger par l'éloge qui precede, que si la commission devait se prononcer aujourd'hui, à se sujet, elle ne balancerait point à donner la palme à la lampe Mueseler.'

"This preference of the Mueseler lamp, by a scientific commission employed upwards of four years investigating Safety lamps, including the Upton and Roberts, the Davy, and all other meriting attention, deserves to be received with the utmost respect for examination in England. This Committee have consequently given it most attentive consideration and trial, and have already accorded it improved light and safety from explosive mixtures passing the flame to the atmosphere around; but most decidedly they object to its general application with its naked glass unprotected by wire gauze. Already they have refused to admit even for consideration two most ingenious lamps, one of Dr. Clanny, and another of Mr. Martin, on the same principle of glass, without gauze, forming the security of the lamp. The facility with which glass may be fractured either by a blow, splinter of coal, fall, or any other such accident, as well as by a single drop of water, when heated, which the glass of the Mueseler lamp would be very liable to, especially in a fiery wet mine, renders a lamp of such construction in a most material point, unsafe. A case quoted by Sir H. Davy corroborates the certainty of this danger.

"M. Gossart, President of the Chamber of Commerce of Mons, in his report on the Safety lamp, states,—"That a director of the works having descended into the Colliery of Tapatouts *with a lamp, of which the base of the cylinder*," *like the Mueseler lamp*, "*was of glass, a drop of water fell upon and broke the glass*, and detached a piece which would have opened a communication for explosion; but the air fortunately at that moment was not adulterated with fire-damp." A visit to a glass work will show at once how

* Second Rapport par la Commission institué à Liege, 1840.

* Second Rapport, &c. &c.

a drop of water, or even the surface of cold steel, will instantaneously separate masses of hot glass nearly an inch in thickness. To such a probable contingency as the fracture of a glass cylinder, then, this Committee, are unwilling to commit the safety of a whole mine; and must refuse the Mueseler lamp their sanction till in this point it is amended. There is also another objectionable point to its regular employment:—Should the flame, by holding the lamp at an angle, not be immediately under the chimney, and the vitiated air escape into the lower part or chamber of the lamp, it is at once extinguished; this is an accident that is likely to occur very frequently in the hands of workmen who are in the frequent habit of carrying their lamps by their sides and oil vessels, and not by the ring at the top. This would originate attempts at re-lighting, if far from a naked light in a dangerous part of the mine, that would probably lead to perpetual serious risks.

"Another point of some importance is the great weight of the Mueseler lamp. Already have strong objections been made to some of the improved lamps by viewers and others on this ground.

"Where wastemen and other officers, for perhaps six hours a day, are obliged to be examining the most dangerous parts of the mine, lamp in hand, frequently in narrow passages, in contorted postures, the weight of the Mueseler lamp being twice that of the Davy, gives a show of reason to such objection. The following are the respective weights of the several lamps:—

	lb.	oz.
The Davy lamp weighs	1	6
The Mueseler lamp	2	11
Dr. Clanny's improved lamp	2	6
Upton and Roberts's last lamp	2	0¼
Stephenson's improved, in use at several mines	2	3½
The Lemielle lamp	1	10½

"To the men stationary at their work this point is less important, nevertheless amongst them all there is a strong disinclination to the employment of a heavy lamp. Hostile opinions on such particulars, it is, however, possible to surmount; but a vital error on the principle of safety it is impossible, nor would it be proper to attempt to overcome. The Committee therefore regret that the insecurity of the Mueseler lamp, from naked glass forming part of its cylinder, renders it impossible for them to recommend its employment, as at present constructed, in the English mines."

On the whole, however, the Committee have felt themselves obliged to come to the following general conclusion, condemnatory of all lamps: a conclusion which has our entire and hearty concurrence.

Safety Lamps.

"The Committee find, after the most minute investigation and careful attention and experiment which they have been able to devote to this branch of their subject, that no mere safety lamp, however ingenious its construction, is able to secure fiery mines from explosion; and that a reliance upon it is a fatal error, conducive to those dreadful calamities which it is intended to prevent.

"The Committee further find, that the naked Davy lamp, without a complete shield of glass or other material, is a most dangerous instrument, and has indubitably been productive of those accidents in mines, against which it is too confidently and generally employed, at the daily imminent risk of producing such calamity.

"The Committee also further find, that the best description of lamp to be employed in fiery mines is one of a perfectly new principle, that of an *improved British and Belgick lamp, in which the supply of air is derived entirely through the upper part of the construction, over the glass shield*, which, from the greater diffusibility of the explosive gases, operated on by the temperature of the lamp, down whose heated interior they have to descend, chiefly enables the atmospheric air to visit the flame: but that, notwithstanding this improvement, the utmost attention must be continually paid to the condition of even these lamps, and still more to those of other descriptions; that the gauze must be examined daily, and every part of the apparatus be ascertained to be perfect; that the workmen must be warned never to continue in an inflammable atmosphere with their lamps overheated by the increased flame; and that, instead of being impressed with the idea that these lamps are absolutely safe instruments, they should be convinced that they are only comparatively safe, and that contingencies may easily arise, in which even the best constructed may be productive of danger and explosion."

(*To be continued.*)

GAS-METER EXPERIMENTS AT THE ROYAL ADELAIDE GALLERY.

[The alleged "Fallacies of Gas-meters," have lately formed the subject of a number of lectures and experiments at this Institution, by Mr. Jones and Dr. Atkins, having, apparently, for their object, to follow up the attack made by Mr. Flower in his pamphlet, on the *water* meters, and on the Companies for using them. Of what may have passed on those occasions (with the exception of the last) we know nothing, except from notices in the

newspapers, too palpably defective and erroneous to be relied on; but having heard that Tuesday last was to be a sort of grand field day, when old water meters were to be tried against new, and dry meters against water meters, we were induced to make arrangements for obtaining the Report of the proceedings, which we subjoin.—Ed. M. M.]

ADELAIDE GALLERY,

(*Jan.* 31, 1843.)

Mr. Jones opened the business of the day by stating that he proposed to begin with some experiments on the water meter, which would show that it was incapable of registering correctly the quantities of gas passing through it, and admitted of the greatest frauds being practised on consumers.

Mr. Wright thought the trial ought not to be confined to the water meter, but extended to the dry meter, which had also its "fallacies."

Mr. Jones admitted the propriety of this, and said, that it was his intention to try all sorts of meters, wet as well as dry, but that he thought it best to *begin* with the common water meter.

Mr. Wright begged to refer to an objection that he had made at a former meeting, to the effect that the fallacy of a standard gas-holder which the lecturer employed in his experiments, would raise the level of the water, and consequently cause a greater quantity of gas to pass than would be registered on the dial-plate of the meter. He still thought that this was a fatal objection to the course of experiments about to be made; and in support of this opinion he read the following letter from Mr. Clegg.

"Sir, — The objection raised by Mr. Wright (that the falling of the standard gas-holder would raise the water in the tank, and consequently discharge a greater quantity of gas than indicated by the pointer) is perfectly correct. The quantity of gas discharged will vary in the same proportion that the extra perpendicular height of the water in the tank bears to the whole depth of the gas-holder immersed.

"I am, Sir, your obedient servant,
"Samuel Clegg.

16, Sidmouth-street, Regent-square, Jan. 30."

Mr. Tweed also objected to the mode of trial proposed to be adopted. It was quite impossible that any reliance could be placed on results so obtained.

Mr. Sharp, Manager of the Winchester Gas Works, said,—I complied with the condition enforced by Mr. Jones on Saturday last, that no discussion should take place during the lecture then delivered by him. I had come some distance to witness the experiments that were advertized to take place, and to hear the lecture, and wished to offer some observations on the manner in which the experiments were conducted, but finding that a rule was laid down that no discussion would be permitted until to-day, I of course complied with it, and have, at some little inconvenience to myself, again attended, for the purpose of making the few observations I intended to offer on Saturday. (Hear, hear.) On coming into the room on that occasion, I found Mr. Jones at his place behind the counter, and Dr. Atkins, as the exhibitor, in the front of it. A question was asked by Mr. Jones,—"Now, gentlemen, I have a number of meters already fitted. Any one that you please shall be tested." Unfortunately, no one spoke. It put me in mind of a very ingenious exhibition by a very clever gentleman, one Monsieur Testet. He borrowed a bunch of keys of one of the company surrounding him, and exclaimed, "Now then, I will allow any one of you to go into the town, and buy three loaves from any baker's shop, and in any one of those loaves you shall fix upon shall be found the identical bunch of keys!" Three loaves were purchased, and brought to him. Monsieur Testet inquired of the company in which of the loaves they wished the bunch of keys to be found. A friend of Monsieur Testet immediately fixed upon the one in which it was; of course he well knew beforehand in which loaf the keys were to be discovered. In making this allusion I do not wish to charge Mr. Jones or Dr. Atkins with conjuration, or with conjuring before this company; but still, there did appear something which I really could not understand, with respect to the manner in which the meter was introduced for trial. I remember perfectly well that Dr. Atkins suggested which meter it was should be tested, and I think I am prepared to prove, by strong circumstantial evidence, that it was well known that the meter in question was very imperfect. It had been tested before, and was chosen because it was, perhaps, one of the worst meters of the lot. (Cheers.) I will tell you my reason for this conclusion. I noticed that there was but one meter fitted with pressure-gauges, and this was the identical three-light meter made by Mr. Jones. I do not know who Mr. Jones is, or where he lives, but I noticed the name of Jones on the plate. In watching the experiments I found it went 2½ per cent. against the consumer at the level water line. An experiment was then made by pouring water, above the level line, into it. The water put in raised the water line ⅝ths of an inch, and the test to which it was submitted made it 15 per cent.

fast—that is, against the consumer. Now, gentlemen, I contend that the experiment was a very unfair one to introduce, because the meter was made imperfect—it was put out of order for the purpose of a particular experiment—(hear)—it was put out of order by pouring into it a pint more of water than ought to be there. (Hear, hear.) I know the reply will be, that "surplus water is frequently found in meters. The inspectors of meters will through carelessness or some other cause put more water into meters than is necessary, and thus consumers of gas are robbed." This, gentlemen, is a sweeping assertion; too sweeping to be substantiated. (Hear.) This discussion is not confined to this room or to London, but the report of it is circulated through every country town lighted with gas, and a dissatisfaction on the subject has arisen. That dissatisfaction must be set at rest by a fair discussion and by proper experiments without any clap-trap in the case. (Cheers.) Mr. Jones also mentioned the mode in which companies could be cheated of gas, and the mode in which he could have deceived us. He said, "Gentlemen, you see the meter stands level; perfectly level. Now I could, if I had chosen, have put a wedge under one corner of the meter, and it would have registered one way, or I could have put a wedge on the other side and it would then have measured the other way." That is all very well to say to parties who know nothing about the structure of meters, and who should happen to be consumers of gas. Why you may as well go into a watch-maker's shop in London and choose one of his best watches and put it to any test you please; you might alter the regulator or throw it off the beat, and might make it one of the worst watches ever made. (Hear.) But I think you will admit that such a test would not prove all the watches in the shop were bad ones, or that the watch so trifled with was a bad one. (Cheers.) I will venture to say that if 100 meters go wrong that at least 90 of them are against the gas companies. (Cheers, and cries of "Oh, oh.") I am not to be censured as a proprietor or as a manager of gas works for the imperfect treatment a meter may meet with. I say it behoves every manager of gas works and inspector of meters to make the consumers acquainted with the construction of the meter, and by doing so they will be watching over their own interests. (Hear.) Something was said respecting a dry meter. (Hear, hear.) There is no one who will not acknowledge that there are defects in water meters which dry meters would remedy—one defect is, that if they be placed in too warm a situation the water evaporates so fast as to occasion great inconvenience. If it be placed in too cold a situation the water will in sharp frosts become frozen and the consumption of gas is stopped. These are very serious evils, and it would be the greatest benefit that ever could be conferred on gas companies and consumers if a dry meter could be established that would answer the purpose. (Hear.) But I fear that at present that has not been accomplished. (Hear, hear, and cries of "Yes.") My firm opinion is that it has not been accomplished. I have been well acquainted with dry meters, having been a dry meter maker myself, and lost a great deal of money in trying to bring it to perfection. (Cheers and laughter.) I supplied many towns with dry meters, of course warranting that they would answer their purpose. But I am sorry to say that I had to pull down many, many hundreds. (Hear.) One reason of their failure was the difficulty of having a metal to make the valves of; a metal that would stand the test of the gas. We found it impossible to get a mixture of metal that would stand the action of the gas. I acknowledge that where the gas is very pure the dry meter would last much longer; but where the gas is impure, which is the case in many towns, the valves were very soon destroyed and the meters of none effect. And it was not only the valves that were destroyed but the diaphragms also, for we discovered that the diaphragms in many hundreds of our meters were destroyed. It will in answer be said, "You had not the right material to compose your gas diaphragms of." I acknowledge it. We went to a great deal of expense, and made many anxious inquiries and endeavours to procure it. We covered our diaphragms over with two coats of leaf gold, but even then they would not stand the ammonia of the gas, the naphtha and the sulphur—these acted on the material and completely destroyed it. I do not wish to say one single word against the construction of the dry gas-meter more than I am able to prove. I contend that the dry meter that has been exhibited here, though different in the arrangement, is in principle the same as mine. One difference is, that it has a sliding instead of a rotary valve, and it has also three diaphragms instead of two, and they are partly cased with metal. They are, however, not thoroughly covered with that material, and therefore it will not afford any protection to the meter, for the gas will act on the parts of the diaphragms not covered with the metal, and the covering will be found to be of no effect. A great deal has been said as to the dry meter—the one which was tested—having been over an oven, I forget how long, but I believe three years. Now, in my opinion, that was the very best situation in which to put a dry

meter (hear.) The place to *try* a dry meter is in a cold and damp situation; for it will not last half the time under such a trial as it will in a warm and dry situation. In the former, condensation takes place, and the material of the meter is soon destroyed. I found in many of my meters a deposit of tar, ammonia, and of sulphur. Now condensation cannot take place, as you are aware, in a warm situation; therefore I contend, that bringing this forward, with big-sounding words of this meter having stood over an oven for three years, is no test whatever of its durability. I have one other note I have taken with which I will trouble you. The meter tested last Saturday night showed, by being put out of order, the registry to be fifteen per cent. in favour of the gas works. Now, with a ten-light meter of Mr. Botten, taken after the lecture was over, the register proved correct to the greatest nicety (cheers.) It was impossible that an experiment could have been more conclusive than the one with this ten-light meter. At present I shall not trouble you further . (Cheers.)

Mr. Defries said that Mr. Sharp admitted his dry meter did not answer. He would ask that gentleman whether Bolton and Watt's first steam-engine answered? (Hear.) He would ask Mr. Sharp two or three more questions. First, What was his diaphragm composed of? Mr. Sharp's diaphragm had two coats of gold; but he (Mr. Defries) would prove that his metal was more valuable than Mr. Sharp's gold. (Hear, hear.) Was Mr. Sharp aware that his meter was tested by two companies before he had it? Was it not Sullivan's meter?

Mr. Sharp.—It was.

Mr. Defries.—Did Mr. Sharp know that it was tested in two gas works in London?

Mr. Sharp.—I do not know.

Mr. Defries.—Then he would tell him that it was, and proved a dead failure. The water meter makers guaranteed their meters for three years; but he (Mr. Defries) had guaranteed his for five years; and he believed he could guarantee them for fifteen years. He could prove that the companies had been guaranteed by him that they should last for five years. Mr. Sharp said that the valves would get out of order, and that the metal would not resist the gas. Now he said, with due submission, that he (Mr. Sharp) did not know what metal would resist the gas. He would give Mr. Sharp further proof in this matter; and that was, that the very gas company who had tried his (Mr. Sharp's) meter, and found it to be a failure, now had one of his (Mr. Defries') meters at work, and had passed 140,000 or 240,000 feet of gas through it, and that under the inspection of as good an engineer as any in the world—Mr. Kirkman. Let the meter which was examined on the previous Saturday, and which had been up three years, be sent for, and opened in the presence of the company; and let them say whether it was defective or not, or whether it had been injured in the least after three years' use. Another of his meters was tested in the presence of two respectable men, Mr. Jones and Dr. Atkins. The meter had been up, he believed, about 18 months, and was said to be a "fast trotter." (Laughter.) That was found to be ½ a per cent. in favour of the consumer. He would rather take the results of such experiments than the opinions of the best engineers in England. With respect to the meter which had been up three years he, too, should be ready, if the company present wished it, to go down with any gentleman to the place where it was, and bring it away in a cab and have it examined at once. (Hear.)

Mr. Sharp.—You asked me if my meter was, before I purchased the patent, tried by two companies. I was not aware of it, but I would say that we went to an enormous expense in our endeavours to make it serviceable. We made many experiments for the purpose of getting a valve that would work. We had glass valves, which every one must be aware the gas will not act upon. But these did not answer, the valve being a rotary one—and we all know that there is dust and that there are particles from the fittings which get into the main—I say that if particles of dust ever so fine, as not to be seen without a microscope, get between the valve and the valve slide, the machine must get out of order.

Mr. Tweed adverted to something which he said had fallen from Mr. Jones, on a former occasion, respecting the influence of change of pressure in causing the water meter to register more at one time than at another, to the great loss of the consumer.

Mr. Jones said that they had not come to that yet, and denied that he had made use of the language ascribed to him.

Mr. Tweed read a passage from some newspaper report of a previous meeting, which seemed to confirm his statement.

Mr. Jones said that he had nothing to do with the reports in the newspapers.

Mr. Tweed.—Well, be this as it may, I beg to ask you whether it is not so, that the quantity registered varies with the pressure?

Mr. Jones.—It does.

Mr. Tweed.—Will you explain the reason why?

Mr. Jones.—We will come to that by and by.

Mr. Tweed said that as this difference

of registration had been much dwelt upon, as furnishing a decisive proof of the incorrectness of the meters, he would at once explain, that all that it amounted to was this, that a greater quantity of gas passed through in a given time, at a high pressure than at a low pressure; but that the consumer paid for what actually passed, and no more. Before sitting down, he would take the opportunity of making what he thought a very fair proposition: namely, that Mr. Jones should name one man of science, and he would, on the part of the meter trade, name another, with power to the two to choose an umpire,—who should have full power to make any experiments they might deem necessary for ascertaining the comparative merits of different meters, as also how far any of them were to be depended upon for giving a just measure of the gas supplied to consumers. He thought that such an investigation by third parties of respectable standing in the scientific world, was the only one likely to be satisfactory to the public; and he, for one, should not at all fear the result.

Mr. Jones cordially assented to the arrangement proposed by Mr. Tweed, and it was arranged that on Saturday next they should meet to carry it into effect.

The experiments nevertheless proceeded as originally prepared.

First experiment—With a ten-light (water) meter, with 7-10ths pressure on inlet pipe, and 6-10ths on outlet pipe; it registered 3¾ per cent. against the consumer. Temperature of the room 72°.

Second experiment—Half a pint of water drawn off; 7-10ths pressure on inlet, and 5-10ths on outlet pipe. Temperature 67°. That effected a change in the registration of 1½ per cent. against the gas suppliers.

Third experiment—Second half-pint of water drawn off; pressure 7-10ths on inlet, and 5½ on outlet pipe. Temperature 69°. Registered 2½ per cent. more against the gas suppliers.

Fourth experiment—Third half-pint of water drawn off; no gas; valve closed. 7½ oz. water added. Temperature 68½°. Pressure 7-10ths on inlet, and 5½ on outlet pipe; then the meter registered 3 per cent. against the consumer.

Fifth experiment—As much water put in as the instrument would hold; it then registered 22½ per cent. against the consumer.

Mr. Jones was called on to test the *improved* water meter of Mr. Botten against Mr. Defries's dry meter. This was accordingly done with a 5-light Botten meter, and the result was that with 7-10ths of the full pressure on the inlet, and (hardly) 7-10ths on the outlet, it registered correctly within one-half per cent. *against* the consumer; while a No. 2 dry meter of Defries, at 7-10ths pressure on the inlet, and a pressure varying from 6 to 6·5 on the outlet, registered erroneously to the extent of 3¾ per cent. against the suppliers of the gas.

Mr. Jones now called on Mr. Tweed to point out the advantages of Botten's improved meter.

Mr. Tweed replied, that the merit which he claimed on the part of the patentee was, that of having overcome entirely, by a most simple contrivance, the objections made to the old water meter, on the ground of variations in the water line. It was impossible to overcharge this meter to the prejudice of the consumers, for as soon as there was the smallest surplus, it was carried off and discharged before it could interfere, in the least, with the going of the meter. The inlet and outlet pipes are the same as those of the common meter; but the water, after entering the case of the meter, passes from thence into the square box in front. In this square box there is a vertical pipe, which is exactly on a level at top with the proper water line of the meter, and opens at bottom into a side chamber containing another vertical pipe, which rises also to the exact level of the water line, and is open at bottom to the atmosphere. The moment the water in the square box rises above its proper level, the surplus passes over into the vertical pipe first mentioned, whence it flows up the side chamber, till it reaches the top of the vertical pipe therein, down which it escapes out of the meter altogether. The improved meter which he (Mr. Tweed) had now brought under the attention of the meeting was not an invention of yesterday; for it had been patented more than eighteen months, and a great many had been put up in different parts; he could not, therefore, help thinking, that it did not say much for the impartiality of the parties concerned in the getting up of these discussions, that it should have been left to others to bring it now under their notice. He must observe, too, in reference to a statement which had been made (by Mr. Flower), that Mr. Botten's meter would be a very good meter, "if they were not *obliged* to be under the sinister influence of the companies," that no objection whatever had been made by any company to the adoption of this meter, nor any sort of "sinister influence" whatever exercised, or attempted to be exercised by them. (Hear, hear.)

The meeting, which lasted upwards of seven hours, then broke up.

The turn which these proceedings are taking, is a little different, we apprehend,

from that anticipated by their promoters. Intended to show that the public are defrauded to the extent of from "2 *to* 32 *per cent.*" by the water meters, they have, so far, but served to show that when these meters are made of the most *improved* form, the extreme variation from a perfectly correct result does not exceed *a half per cent.* Instead, moreover, of their paving the way for the universal substitution of *dry* meters,—that is, of course, of "*the best*" dry meter, which the Diogenes of Bridge-street protests is that of his friend Mr. Defries—they have elicited this startling fact, that Defries's "best" may be wrong to the extent of 3⅞ths per cent., or nearly eight times less correct than Mr. Botten's improved water meter. We have looked in vain for any satisfactory proof that even the worst of the old water meters have ever given such false results as has been alleged. To Mr. Flower's statements on this head we pay no heed whatever; he wants both the science and judgment necessary to distinguish between what is true and false in a case of this sort. On the experiments of the Gallery lecturers we place just as little reliance—made, as they confessedly were, to establish a foregone conclusion—made with meters, selected, perhaps damaged, for the occasion—and tested in a way which is a perfect mockery of scientific investigation. Mr. Wright's objection to the mode of experimenting followed was unanswerable; and Mr. Sharp's exposure of the conjuring character of the whole affair, as happy as it was conclusive. Should the reference to men of science proposed by Mr. Tweed be carried into effect, we shall look with some curiosity for the result; though, certainly, a report in favour of the absolute accuracy of either of the sorts of meters, is by no means what we would anticipate. It would be idle to expect that an instrument, subject to so many constantly varying influences, as temperature, pressure, &c., should itself never vary. The public ought to be well content if it registers within a good many degrees of the truth. Any thing, surely, in preference to a return to the old random contract system, under which the man who consumed 100 cubic feet of gas had commonly just as much to pay as he who consumed 1000. The meter system, with all its imperfections, real and imaginary, is a vast improvement on the side of the public interest over that which it superseded, and we do not think it is likely to give place soon to a better. Nor ought people to forget, when carping about short measurement, how much is lost by the way in bringing the gas through miles of pipes to their doors. We have never heard the loss to the companies from leakage of pipes estimated at less than 15 per cent., and there are well established cases of its amounting to from 30 to 40. Consumers should consider these things; and, on the principle of giving as well as taking, should be satisfied if there is anything like a fair balance struck between them and the companies. And that the balance must, on the whole, be pretty fairly struck is evident from the fact adverted to in our last, and which we believe to be incapable of contradiction, that the companies do not, on the average, derive more than the ordinary rates of interest on their invested capitals,—and from this further consideration, that the companies are so numerous, and capital wanting profitable investment so abundant, that any thing but the briefest possible monopoly, or any undue advantage (such as charging by the quart measure, and supplying by the pint,) could not possibly exist.

PHOTIC FLUIDS.

Sir,—I must express the great regret I feel at perceiving how completely I have been misunderstood by your correspondent "Z." He says that I *evade* his two new propositions, evidently conceiving that my intention was to dispute, and if possible overturn, his whole theory; and as it is clear from this that I cannot have explained my meaning properly, I must once more trespass upon your columns to repair my error. If I understand him right, his propositions are three:—

1. That vibration is caused by the active predominance of positive photic fluids, and that the seat of the cause is in the hollow

centres of elemental atoms holding ether fraught with photic fluids.

2. That the ponderable elements consist of inert radicals, chemically combined with fixedly condensed photic fluids contaminated with terrestrial effluvia.

3. That these photic fluids are six, which exhibit themselves in the forms of positive and negative electricity, positive and negative galvanism, and positive (white) and negative (black) light—of which each pair mutually "combat and repel" one another; "absorbing and neutralizing," or else "combining and mixing" with each other according to circumstances.

Now the two first certainly are new to me, and, for all I know, may be perfectly true; but I make no comment on them, simply because I do not as yet sufficiently understand them. The third proposition is, however, totally different; it is decidedly old, and in my opinion false. Therefore, the fact of my having passed over, and thus virtually granted, the two first must not be alleged as a reason to prevent my disputing the last, which was the sole end and aim of my last letter.

The circumstance of my having few books at hand will prevent my proving my position as well as I could wish; for the only well-known instance which I at present remember of the "opponent* fluid's" theory, is the long exploded one of phlogiston and antiphlogiston, the postulated causes of combustion and of its extinction. It was in most respects perfectly analogous to your correspondent's third proposition; phlogiston being in the situation of his positive, and antiphlogiston of his negative fluids (excepting the centripetal and centrifugal tendencies which were not then thought of); and all that has ever been written to prove combustion to arise from chemical combination, (or "atomic vibration,") and its extinction from cessation of such vibration, will equally well prove, until some contradictory *fact* be discovered, that electricity, galvanism, light, and heat, each owe their origin to some agent, which is occasionally passive, and its passiveness produces the effects exactly contrary to those of its activity. I admit the existence of photic fluids, and I admit every flame to be a means of exciting the activity of some one fluid, (which I am quite willing to call positive,) and thereby producing the effect we call "brightness;" but I do *not* admit "the predominance of darkness," which surrounds its sphere, to be due to the activity of a second "negative" fluid, but merely to be caused by the absence or passiveness of the first or positive. This is the point at issue between us; and as this explanation will, I hope, clear up the obscurity which seems to have pervaded my last letter, I will not repeat anything more I there said; but trust to the candour and judgment of your correspondent "Z" to decide whether my "objection" be a "substantial" one or not, assuring him that, whenever he proves the existence of any important phenomena which can be explained by the theory of duplicate "opponent fluids," and not by that of a single fluid, he will find no readier disciple than the anxious and inquisitive seeker after truth, who remains

Your obedient servant,

COGITO.

P.S. There was a slight mistake in my last letter—whether mine or the printer's, I know not. Page 21, line 10, it stands "the slight degree of vibration which is *sufficient* to affect," &c.; it should be "which is *insufficient*," as the context shows.

* In adopting the phrase of my "*antagonist*," I must assure him that I bear him neither "ill-will" nor "malice," and appeal to Johnson to prove that, though I used different words, my meaning was much the same, only a little more general.

"Antagonist: 1. *opponent*; 2. contrary; 3. in anatomy, a muscle which *counteracts* another.

"Essence: 3. being, existence; 6. constituent substance."

Therefore, "antagonist essences" means "opponent existences."

DEMPSTER'S NEW MODE OF CONSTRUCTING AND RIGGING VESSELS—(SEE MECH. MAG. VOL. XXXVI., P. 504.)

The following Report of a Committee of the Society of Arts, dated Dec. 30, 1842, was read and approved of at a Meeting of the Society on January 9, 1843:—

"Your Committee met at Leith, and, assisted by several naval gentlemen, saw Mr. Dempster manœuvre his little vessel called the *Problem*. The day was not so favourable as could have been wished, from the wind being very light; but yet your committee saw sufficient to enable them, with the concurrence of those gentlemen who kindly assisted, to report, That the invention, as regards shape of hull and form of rig, is not such as could recommend it to either the Navy or the Merchant Service. But they are of opinion that, from the facilities afforded by this plan, as far as can be judged from the experiment exhibited, it might be well adapted for pleasure yachts under forty tons, or for training youths in naval tactics. This form gives peculiar facilities in tacking, rendering it impossible to miss stays, and performing that manœuvre

in much less time than can be done by the usual mode of rigging, &c.

"The *Problem* stood very near the wind, and made very little lee way; and one gentleman, who tried his yacht along with her on a previous day and having plenty of wind, gave her a high character as a sea-worthy boat, and as performing her work in a handsome manner; and he added that, were he changing his yacht at present, he would be inclined to adopt this plan in the construction of a new one.

"Your Committee are quite aware of the difficulties that attend hazarding an opinion on a construction of hull and rig, before it has been tried on a vessel of the full size to which it is adapted: they are also aware that many advantages as well as obstacles, unlooked for from experiment, often exist; but they, in this case, do not contemplate any that can materially impede its efficiency, where a considerable draught of water, and carrying a small cargo in proportion to tonnage, are not objections.

"They unanimously testify to the ingenuity and perseverance of Mr. Dempster in his experiments, and to the ready manner in which he and his *Problem* act and manœuvre; and, if in consistence with the rules of the society, they would beg to suggest that some assistance of a pecuniary nature should be given to Mr. Dempster for what he has already done.

"All which is humbly reported by

(Signed) "WM. CRAWFURD, Convenor.
J. H. TAIT, Rear-Admiral.
P. STODDART, Rear-Admiral.
ALEX. HAMILTON, Secretary Yacht Club.
WILLIAM GALBRAITH, Teacher of Mathematics.
THOMAS MENZIES, Shipbuilder.
JAMES COWAN, M.D., R.N.
WM. ARCH. SMAIL, Lieut., R.N.

CURIOUS CHANGE OF COLOUR OBSERVED IN IODIDE OF LEAD.

Sir,—Having had occasion to prepare a small quantity of iodide of lead, and being in a hurry to have it dried, I applied the paper filter containing it to the heat of a fire, when to my great astonishment the iodide instantly changed from its natural colour (pale yellow) to that of the most dazzling vermilion. At this period I formed an idea that I had discovered a most beautiful red pigment, but, lo! as soon as the compound became cool, the dazzling tint had fled, to my indescribable disappointment. However, I found the same phenomenon was reproducible at any required time by the application of a moderate warmth.

I should not have sent this account of what I observed, but that such a thing has not been previously mentioned, not even in the most recent chemical works. In all likelihood some of your numerous readers may be able to furnish a theoretical explanation.

I am, Sir, yours obediently,

GALEN.

February 1, Sunderland.

SEA GUTTERS, OR MARSH LAND DRAINS—ENQUIRY.

Sir,—Having been a constant reader of your Magazine for some years past, from which I have derived much information and many useful hints, allow me, through the same medium, to make a few enquiries on a subject of great interest to myself and others in very many parts of the kingdom.

The enquiries alluded to, relate to sluices or drains, usually called sea-gutters, in common use for draining marsh lands, through outlets into the sea. It is at all times difficult to obtain practical information on the subject, and few like to venture on experiments without some basis, as an unfavourable result might be destructive of the property intended to be protected.

The information I wish to obtain is—

1. The best kind and material to be used for sea-gutters.
2. The comparative cost of wood, iron, stone, slate, or other material used.
3. The advantages and disadvantages of either, and where to be seen in use.
4. Whether sea-gutters of iron have been found to answer well, and how far are they affected by salt water, and their best mode of construction.

I am, Sir, yours very obediently,

GEORGE WOOD.

Rochford, January 24, 1843.

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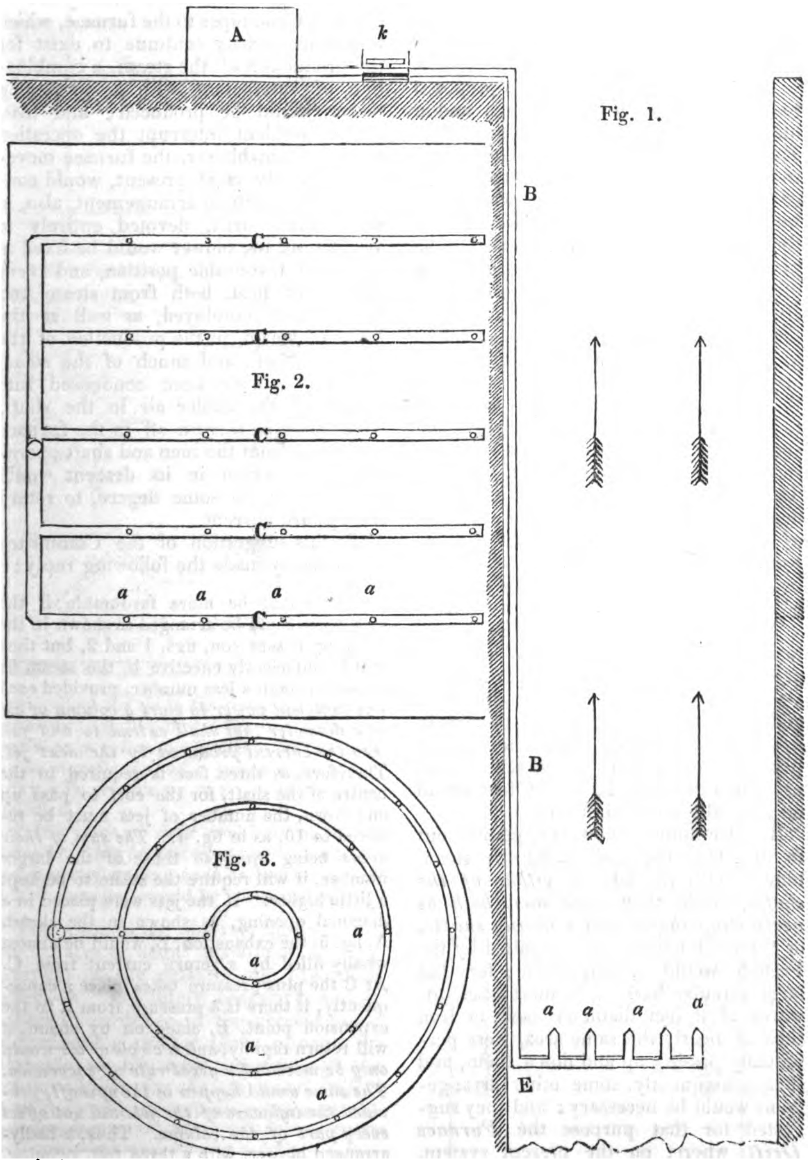
GURNEY'S HIGH-PRESSURE STEAM APPARATUS FOR THE VENTILATION OF MINES.



MR. GOLDSWORTHY GURNEY'S HIGH-PRESSURE STEAM APPARATUS FOR VENTILATING MINES.

We have quoted, in our Second Notice of the Report of the South Shields Committee, (see page 100 of our present Number,) the high praise bestowed on Mr. Gurney's high-pressure steam mode of ventilation; and propose to give here the details of the plan, as furnished by Mr. Gurney, with some of the illustrative engravings.

From a boiler, A, fig. 1, it is proposed to carry a pipe, B B, one inch and a quarter in diameter, down the upshaft to E—say 20 or 30 feet deep. The pipe is to be made to communicate with a series of pipes, C C C C C, as shown in the horizontal section, fig. 2. Screwed into the pipes, small jets, *a a a*, are to be placed at about a foot distant from each other. Assuming the upcast to be about six feet square, Mr. Gurney considers that twenty-five jets would be sufficient to produce the rate of draft required; a larger number, however, would increase the draft current. If the shaft is round, (and Mr. Gurney thinks a cylindrical shaft preferable to a square one,) the arrangements might be as shown in fig. 3. The velocity of the currents of air would depend entirely on the pressure of steam, as it escapes at the orifices of the jets *a a a*. The pressure will be governed by the boiler, and regulated through the jets by the stop-cock *k*, fig. 1.

Mr. Gurney considers it to be immaterial where the steam blower is placed, provided there be a sufficient column of air above to keep the current uniform; and although the pipe B is supposed, in fig. 1, to be carried down the upshaft from 20 to 30 feet, he thinks that in practice a depth of 10 or 12 feet would be generally found sufficient.

The Committee, however, pointed out to Mr. Gurney, that fixing the steam blower with its jets in *either of the shafts*, while they were used *both as ventilating shafts and winding shafts*, or "pits of extraction," as called by the French, would be impossible; for that large circular baskets, in most cases upwards of 3 feet diameter each, or iron tubs of nearly the same area, were perpetually passing up and down them, and that, consequently, some other arrangement would be necessary; and they suggested for that purpose the *Furnace Drift*, where, on the present system, the spring of the existing ventilation was placed.

The chief reasons assigned were:—That it would be more in accordance with the established usage of pitmen to have it so placed, and that merely adding the boiler and pipes to the furnace, which would necessarily continue to exist for the production of the steam, a combination of rarefaction with a propelling power would be produced; and that, should accident interrupt the operation of the steam-blower, the furnace movement, exactly as at present, would continue. By such an arrangement, also, in the furnace drift, devoted entirely to ventilation, the blower would be fixed in the most favourable position, and every particle of heat, both from steam and fire, directly employed, as well as the force of steam, in the production of the desired effect; and much of the steam that would have been condensed into water, by the colder air in the shaft, would then be thrown off in the furnace drift, free from the men and shaft operations, and which in its descent would have tended, in some degree, to retard the upward current.

To this suggestion of the Committee Mr. Gurney made the following reply:

"It would be more favourable if the steam jets could be arranged as shown in the drawing I sent you, figs. 1 and 2, but they will be sufficiently effective if the steam be passed through a less number, provided *each has sufficient power to start a column of air of a diameter that shall extend to and fall into the current produced by the next jet.* Therefore, as three feet is required in the centre of the shaft, for the corf to pass up and down, the number of jets must be reduced to 10, as in fig. 4. *The sum of their areas* being *equal to* those of the larger number, it will require the steam to be kept a little higher. If the jets were placed in a diagonal opening, as shown in the sketch A, fig. 5, the exhaustion, B, would be almost wholly filled by a return current from C. At C the plus pressure takes place; consequently, if there is a pressure from it to the expansion point, B, acted on by steam, it will return rapidly, and *a circle of air would only be moved at a great rate of succession. The same would happen in the upshaft, provided the influence of the jets did not affect every part of the column.* Thus, a badly-arranged blower, with a three feet opening,

Fig. 5.

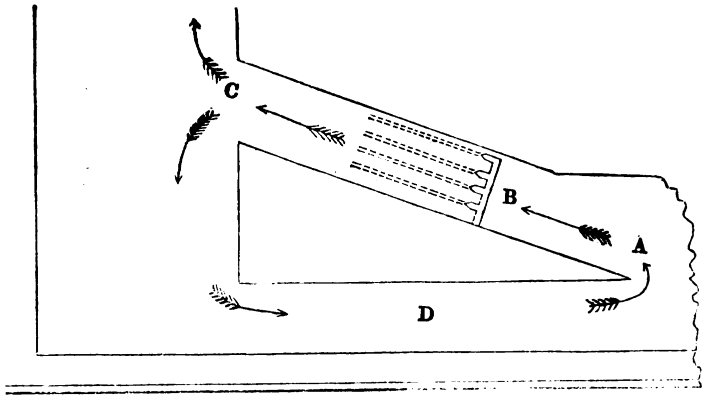


Fig. 4.

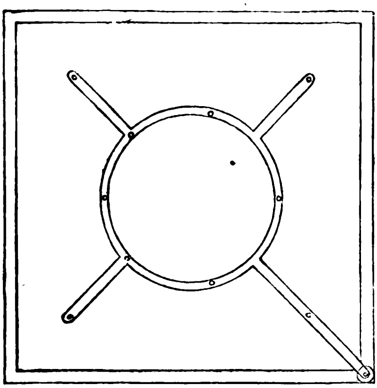
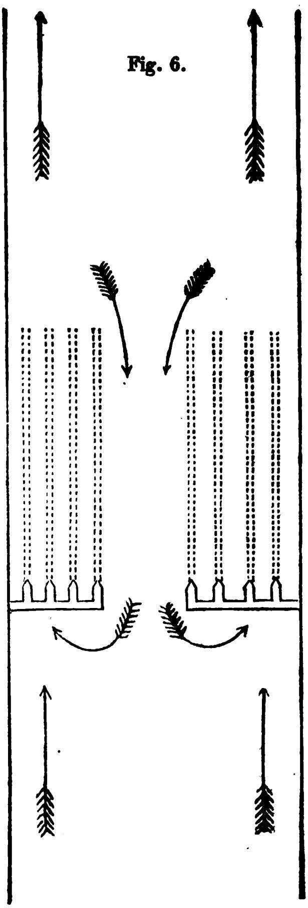


Fig. 6.



would affect the air in the shaft as shown by the arrows, fig. 6; *therefore, it will be essential in practice to take care that the jets are so placed, and of a power sufficient to* MOVE THE WHOLE OF THE AIR *in the given direction.*

"If a valve or door could be placed at about D, '*the blower would act as well in the diagonal gallery as in the upshaft;* but this, I conceive, would be inconvenient.'"

The Committee observe, on this, that the "valve or door" mentioned by Mr. Gurney, at the close of the preceding letter, is "absolutely necessary, and is always in existence in the present mode of ventilation, *so that there appears no obstacle to the easy adoption of the steam blower in the furnace drift.*" And they add the following general observations:—

"An objection is frequently made to

mechanical means, by some practical men, because it necessarily is liable to be injured and broken, and on such an occurrence would expose the whole mine to danger. But the combination suggested by the Committee would obviate entirely this difficulty, and there is no machinery here to break or get deranged. A strong boiler and pipes will not easily be affected, and when they get wrong, they can soon be repaired; or even at the worst, if the fire for one or two days is obliged to be put out, should they not have another boiler, as suggested by Mr. Gurney, they can only do as many of them now do, for a day or two every fortnight, when repairing brattices, put on a small water-power in the downcast from a pipe an inch or inch and half diameter, which will be quite sufficient for ventilation till all again is ready. The objection seems more tenable against a fan apparatus, air-pumps, or other mechanical means in which machinery is in powerful and rapid motion, than against steam ventilation with the furnace in which no such action exists, and, indeed, to which it cannot in any manner fairly apply."

THE SOUTH SHIELDS REPORT ON ACCIDENTS IN COAL MINES.—SECOND NOTICE.

COMPLETE VENTILATION is, in the opinion of the Committee, the only means by which inflammable mines can be worked with safety. In every case there is ventilation, more or less: but, since the introduction of the misnamed safety lamps, it has been much less attended to than before, and is now generally regarded as a matter of very secondary consideration. To such an extent has this neglect of ventilation been carried, that there is an instance mentioned by the Committee of a mine, in the neighbourhood of Newcastle, which, before the safety lamp came into vogue, was worked with five shafts, about 6 feet diameter each, but has now only two. In the Wallsend collieries, which are under the superintendance of the celebrated viewer Mr. Buddle, there is no air-course longer than four miles, and the air seldom travels at less than ten feet per second; and less than the ventilation indicated by these rates is considered by that gentleman, albeit no "humanity-monger," as being incompatible with the safety and welfare of the miners. But the Committee mention one case of a mine 850 feet deep, with from seventy to seventy-five miles of passages, which has only one shaft, of less than 6 feet by 5 square, "to supply the entire mine with fresh air for men, horses, lamps, and fire, as well as to keep the inflammable gases below the explosive point;" and in which, consequently, the air travels at the rate of only $1\frac{1}{10}$ feet per second; a second, 1,000 feet deep, in which the current is as slow as 1 foot per second; and a third, 1,580 feet deep, in which the air *creeps* at the rate of only ·66 of a foot per second, or much under half a mile an hour. What else than a succession of the most frightful disasters can be anticipated from so disgraceful a state of things? "That the air thus struggling through extended passages, where oozes gas at every pore, at a rate of 30 cubic feet per second, should become surcharged and explosive, is (as the Committee forcibly observe) a physical consequence as clear as any mathematical demonstration. In such a system there is every thing to encourage the production of an explosive mixture—just sufficient air to prepare, in some neglected recess, the combustible—*not enough to dilute or sweep it away.*" It is only matter of surprise that such lamentable accidents as the St. Hilda explosion, instead of being occasional, are not so incessant and destructive as to put an end to the working of the mines altogether. The Committee ascribe this to the continual watchfulness and knowledge of dangerous symptoms, "which the circumstance of living always on the verge of destruction" has produced amongst the officers and men; and not at all to the use of the safety lamp, which, for the reasons quoted in our last, they think has but served to increase the danger.

"The Committee are therefore obliged, from a strong sense of public duty, to record their conviction, derived from personal inspection of many mines, and the fullest official information of many others, that the system and rate of ventilation of the mines in this extensive coal district *require a great and important change;* for if allowed to continue, there is scarce a single mine amongst them, with one or two rare exceptions, that in a day or hour may not be

plunged by some easy contingency into a destructive explosion; and that this state of things is produced by too few shafts to the extent of underground workings, and the consequent slow rate of air which is produced to sweep the passages rapidly to remove or fully to dilute the gas."—Page 36.

More shafts and more air, are therefore the grand remedies required. The Parliamentary Committee of 1835 were led to believe that these remedies could not be adopted on account of the great expense attending them, and they have so reported. But the present Committee have, in our opinion, most successfully demolished this objection.

"This Committee have observed with regret that the Commons' Committee of 1835 had been erroneously impressed, and endeavoured to extend that impression, that the enormous cost of sinking a single shaft precluded the possibility of attempting a second for the same colliery; that no proprietors, considering the nature of the speculation and profits, would be induced to advance so large a capital as would in such case be required, and that consequently should such a system be brought into operation, a number of valuable collieries would thereby be thrown out of existence.

"When Mr. Taylor was recommending to that committee (280) more numerous shafts for ventilation, they asked him 'if he was aware that the *cost of sinking a single shaft* would frequently, in the counties of Durham and Cumberland, *exceed* 100,000*l.* ?'* and when Mr. Garforth, of Lancashire, is telling them that though they have there feeders of water and quicksands to contend with, yet they can sink a shaft of 11 feet diameter 250 yards, and properly walled, for 1,200*l.* to 1,500*l.*, a little more than 5*l.* a yard, they astonish him by stating, '*that in many districts of the north a shaft of the same diameter, and to the same depth, would cost* 50,000*l.*'†

"These assertions of that Committee are entirely unsupported by the facts of the case, and seem to be an extraordinary exception or two (such as Monkwearmouth, said to have cost 80,000*l.*), which they have entertained as the ordinary scale of sinking, instead of the usual and average cost of such an operation. Mr. Buddle himself, in describing an instance *of the worst description*, and reasoning against the sinking of more capital in the same mine by more shafts, admits, that he cannot give the Committee an idea of the expense of sinking *difficult shafts*, but, '*he believes there are some that have cost* 40,000*l.* and upwards to reach the coal.'* Now Mr. Buddle, with his very extensive experience in every description of mine—and a man of his eminence would be certain to be consulted in almost every *difficult* case—cannot affirm that he KNOWS of any shaft that has cost 40,000*l.*; but 'HE BELIEVES THERE ARE SOME.' Although a gentleman experienced in all the difficulties of his profession, and a coalowner himself, he knows no case where a shaft cost that amount; yet the Commons' Committee impress upon their evidence that there are some cost 50,000*l.*, and in several cases exceed 100,000*l.* On this point, of such vast importance to the mines, it is deeply to be regretted that the Committee had not instituted a series of inquiries that would have elicited correctly the exact expense of shafts of different depths and diameters in various localities in the several mining districts. They would thus have produced most valuable information for the future safety of mines, as well as their economical working, and, this Committee feel assured, would have placed the above extraordinary sums in very striking contrast with the real amounts of cost.

"From the best information which this Committee has been able to obtain, shafts can be sunk even in this *difficult coal district*, ON A REGULAR AVERAGE, *at least from* 70 *to* 80 *per cent. less than stated by the Commons' Committee:* the mere sinking of the shaft and walling not amounting to much more than stated for Lancashire. A single 11 feet pit, down for 300 yards, would not cost more, under ordinary circumstances, than 2,000*l.* to 2,300*l.*:—nor would a 14 feet pit, for the same depth, require a greater sum than from 2,500*l.* to 3,000*l.* But as both for reducing such *feeders* of water (some of them, 1,000 gallons a minute, or, as at Haswell, upwards of 26,000 tons a day,) which are probably to be met with in the shaft, generally from 30 to 70 fathoms down, till the tubbing or caissons are fixed, and also for keeping the mine afterwards clear, a large pumping engine of from 200 to 300 horse power, is generally required:—For example, if of 250, there will be an additional expense of about 5,500*l.* for an engine with its masonry, &c., but which is as much for the mine as the shaft, and only one generally, besides winding engines, for the sinking of two or more shafts, need be erected on a single colliery.

"The Committee have data before them showing the expense of sinking some ventilating and winding shafts 8 feet diameter, nearly 200 yards down, that did not amount

* Parliamentary Evidence, 281 and 2.
† Idem., 3,755, 6, and 7.

* Parliamentary Evidence, 2,150.

to 3*l*. per yard for sinking and walling; and one 11 feet engine pit that cost less than 5*l*. per yard. These shafts were lately sunk in this district, and there was only one 250 horse engine at the largest. On the same system, two shafts at least may be invariably put down under the operation of one pumping engine, absolutely necessary to be afterwards employed. After one shaft is sunk, or when it is being in progress, without there be some extraordinary and unusual quicksand or feeder of water, a second is put down much more easily, as the first serves to drain and keep the other dry, if placed within a reasonable distance. As a proof of a better light dawning on this point, the Committee have the satisfaction of observing that two 14 feet shafts for one mine, are progressing simultaneously in a *difficult district*, though they will have to be sunk nearly 400 yards, before reaching coal.

"A solitary instance at Datton-le-Dale, in the Durham district, of an almost impassable quicksand, which required many months' exertions, and a power of engines of 1,274 horses, never before employed at a colliery, must not be taken as a rule, but another striking exception to the facility of such operations. Yet even in this extreme case, so satisfied are the intelligent owners and viewer of the necessity of abundance of shafts, that, though they have two 14 feet pits within 45 yards of each other, they are expending this immense labour and cost to add another of 16 feet diameter within a 55 yards' range of them. Perhaps had they planted this pit at the limits of their intended ventilation, if not to be used chiefly as an engine pit, it might, in addition to avoiding the quicksand, have been more advantageous as an upcast, saving the waste of a return current and the friction of half its extent.

"The average rate, which should rule, is such as has been stated: and when it is considered that the repairs of a bratticed shaft not unfrequently amount to from 1,200*l*. to 1,500*l*. annually, and that the cost of one or two small ventilating shafts, of 6 or 8 feet diameter, will, in most instances, amount each to little more, it surely is both consistent with humanity and economy invariably to adopt them.

"It is difficult to form an exact opinion as to the number of shafts required for an extensive mine, which vary somewhat according to circumstances; but considering that in the metallic mines of Cornwall, as deep as the coal mines of the north, for the sake of healthy ventilation alone, they have shafts not more than 300 yards from each other:—that in Staffordshire, where gas and danger are not so abundant from their average depth being about 75 fathoms, they generally have their shafts for the same purpose not further apart than 300 yards, which ventilate not more than 15 to 16 acres each:—that in Lancashire, they almost never sink less than two or three shafts together; and that Mr. Buddle, the great improver of ventilation in the north, has for Wallsend, 140 fathoms down, 4 shafts for about 130 acres, two of them 6 feet diameter; it appears reasonable to conclude, that *in no case ought there to be less than one ventilating shaft, however small in diameter, apportioned to, at the least, every* 40 *acres;* and that no '*winning*' should be allowed to be made, UNLESS TWO DISTINCT SHAFTS HAVE BEEN PREVIOUSLY PUT DOWN, which should be secured by Act of Parliament.*

"In the arrangement of the downcast and upcast shafts it is necessary to keep in view that the latter, in furnace ventilation, should always be at least as large as the former, because there is fully ⅐th more expansion in it; taking the average difference of temperature in the two shafts at 70°, which is low. If as much as in some particular pits at certain periods, the proportion would be still greater. The unfortunate error exists of almost invariably having the areas of the downcasts greater than those of the upcasts, sometimes in a proportion of nearly 2 to 1, it not being observed that the expansion by heat, after combustion of the products of the air, the nitrogen and carbonic acid gases, acts directly as an obstruction, and consequently reduces the admittance of air through the downcast by that amount, which is only partially relieved by the increased velocity of the upcast. Mr. N. Wood 'thinks the area of the upcast pit ought to be larger than that of the downcast pit.' Mr. Smith is also of the same opinion; or the velocity must be greatly increased to remedy the defect.†

"Even with the more abundant sources of ventilation, above detailed, it is necessary not to neglect the improved advantages which modern science offers to set in motion the columns of air that present themselves in these shafts. If the current be still allowed to creep sluggishly through an 8 or 10 miles' course, at a rate, in many parts of not more than 1 foot per second, no great advantages will be derived from the proposed change.

* George Stephenson, Esq., conceives ventilation is a clear subject of arithmetical calculation. He thinks "if a certain current *could be by law* forced up to the neighbourhood of the mine in a certain area of space it would be a great certainty as to preventing explosions: he does not know whether such a law could be carried into execution." When asked if there is a total ignorance of any theory as to the required extent and nature of the supply of air, in answer, "he believes quite so."—Parl. Evid. 1802 and 3. He also thinks a code of laws might be established to prevent accidents in mines, though he could not give a decided answer.—Parl. Evid. 1813 and 14.

† Parliamentary Evidence, 924—3859.

For if a mine discharges gas at the rate shown at the commencement of this report, or approximates even distantly to the proportion as instanced from 5 acres, there will be produced an enormous body of gas in the 24 hours, which ought to be diluted and swept away, not by the dangerous proportion of 25 or 30 times its own bulk of air, but by a quantity infinitely further removed from the chance of accident."—pp. 40—42.

The best method of producing the necessary current of air, is, in the opinion of the Committee the projection of high-pressure steam up the upcast shaft in the manner proposed by Mr. Goldsworthy Gurney to the Parliamentary Committee of 1835. The resemblance between this method and that adopted to produce the draught in locomotive engines, will at once strike the reader. We have given, in the first article of our present Number, the details of Mr. Gurney's system, and shall only insert here a brief extract from one of his letters to the Committee, explanatory of its advantages.

"I believe the cost of ventilation by high-pressure steam will not exceed that of the rarefied column as produced by the furnace now in use for low velocities; for high velocities it stands alone and admits of no comparison. The great value for the purpose of ventilating coal mines, consists in the fact, that there is no practical limit to the velocity of the current of air it is capable of producing under proper arrangement, the cost of which, I have reason to believe, will be the quantity of the current multiplied by the squares of its velocity. In addition to the current of extreme velocity that of its being regulated at will and according to circumstances, render it peculiarly available for the practical purposes of coal mine ventilation. When applied to produce exhaustion, I have in experiment carried it so far as to raise a column of water 4 feet high, and when applied on the condensed principle, I have produced a plenum, which raised a column of water 5 feet; this was on a large scale. On a small scale I have raised a column of mercury 9 inches. From these data you can calculate the immense velocity of current which may be produced in extreme cases, if such, which is improbable, can ever be required for discharging fire damp."—p. 45.

The Committee add some just animadversions on certain erroneous statements and views on this subject, contained in the Report of the Belgic Commission. Both M. Cauchy and M. Gonot, speak of steam ventilation as having been suggested by a "Monsieur Taylor," and assume that the steam is to be conveyed down from a boiler on the surface to the bottom of the pit, and then through the galleries to the upcast shaft. The Committee observe on this:—

"M. Gonot, in recommending the steam to be brought from boilers at the surface, in a pipe, to the bottom of the upcast, and there, with its mouth turned upwards, the whole volume to be discharged into the entire column of air, does not appear to intend any thing more than its rarefaction, or, if he thought to aid it by the force of steam in such construction, he seems not aware of the almost certainty of injuring the intended effects, as pointed out in Mr. Gurney's lucid exposition, by producing a circular instead of a perpendicular ascending movement, effected by the partial application of the steam acting only on a portion of the column. M. Cauchy, the reporter, in detailing the recommendation of another memoir, uses the term, '*vapeur à haute tension*,' as if an indistinct idea was entertained of employing the forcing action of steam at high pressure, as well as its rarefying power. The plan of operation proposed by M. Gonot, and favourably introduced by M. Cauchy, would tend only to disappointment, if any other motion was anticipated than that by rarefaction.

"The following extract from a note of Mr. Gurney's, date June 3, 1842, will explain his opinion of the Belgian views:—

"'In regard to Mons. Gonot's paper, you will observe, on a closer examination, that he *entirely overlooks the just principle* in the action of steam for coal-mine ventilation, and only treats of a weak and ineffective modification for heating air, which has been proved over and over again to possess little, if any, advantage over the ordinary mode of ventilation by the furnace. This seems to me very extraordinary; and I think your report may be considered more valuable if this fact be pointed out, while attention is drawn to the importance which has been attached to steam as an agent for ventilation by scientific foreigners, one of whom has been rewarded by 2,000 francs, principally on account of proposing a comparatively powerless application.

"'I think it well to remark that the mode, as I have proposed it, may, in case of danger, or under local circumstances requiring it, be carried to any distant or obscure spot in the galleries, and made to effect any intensity of ventilation there; and if at such distance as to receive too much loss by condensation, compressed air may be substituted for steam, to produce the same amount of

current: of course, with increase of expense, which the nature of the necessity must sanction.'

"As Mr. Gurney, so early as 1835, made to the Commons of England the suggestion of high-pressure steam for ventilation, which was then recorded and published, it displays considerable ignorance of this subject, in M. Cauchy and the authors of the memoirs explaining it, to adopt for recommendation a very imperfect mode of its application; and it can scarcely be permitted, four or five years afterwards, in Belgium, that the suggestion of steam ventilation should be ascribed to another.

"This is one of those public errors which require only naming to be rectified. If the mere hint of steam ventilation be sufficient to secure the merit of a discovery, then does it really belong to Mr. Buddle, of Wallsend; for so early as 1813, in his letter to Sir Ralph Milbanke, on the prevention of accidents in mines, he explains and gives a drawing of ventilation by steam, in which, from a boiler like M. Gonot's, on the surface, steam is conveyed down a pipe covered with wood a little distance into the upcast shaft, where, by its heat counteracting its direction, it forms a sort of rarefied ventilation. But he does not himself approve of it, and no wonder. The pipe at its extremity is not curved even to open upwards, like M. Gonot's, so that the force of the steam's motion operates against that of its expansion —one principle counteracting another; the former of which, the force, by a proper apparatus on Mr. Gurney's plan, *if required*, is strong enough to propel, in its own direction, the entire column with inconceivable velocity through the galleries, reversing Mr. Buddle's motion by steam rarefaction into one in a contrary direction. The more such an apparatus as Mr. Buddle's was exerted, the less ventilation would probably, except in a wrong course, be produced. It is even a worse arrangement than that of M. Gonot's; yet is deserving the credit of an original attempt at a beneficial change."—P. 47.

(*To be continued.*)

SCOTT'S PATENT IMPROVEMENTS IN CAST IRON, WROUGHT IRON, AND SOFT METAL PIPES.

[Patent dated, July 6, 1842; specification enrolled, January 6, 1843.]

Since the vastly extended use in recent times of pipes for gas lighting, and heating by air, water, and steam, a ready mode of joining numerous lengths of pipes tightly together, and of disjoining them again at pleasure, has become every day more and more a desideratum. The old spiggot and faucet joint, commonly used for cold water pipes, was never, even with the aid of the best soldering, a very sound one; and when applied to pipes constantly subject to heat, or to the pressure of highly elastic fluids, proved utterly useless. The various sorts of flange and thimble joints were found but little better. The cement joints of the butt, mitre, and T forms, now so commonly used by gasfitters, are, under ordinary pressures, sound joints, and soon made; but, like all joints depending for their tightness on cements, which must be applied in a hot state, they are unavoidably the cause of a good deal of trouble, and of some cost, when one pipe, or any number of pipes of a series, is required to be removed for repair or renewal, or for any purpose of temporary convenience. In the right and left hand screw joint, introduced by Mr. Perkins, mechanical pressure has been substituted with excellent effect for the ordinary cements; but this, too, is liable to the objection that any pipe of a series thus jointed together cannot be removed or replaced without great difficulty. Mr. Perkins endeavoured to obviate this objection by an improvement which he patented a year or two ago, though with but indifferent success. What was still left wanting by all who had applied their ingenuity to the subject, was a mode of connexion, at once perfectly tight and easily dissolvable—a sort of joint which could with equal readiness be made and unmade—and in the unmaking thereof be attended with little trouble and no expense.

We have now the pleasure of laying before our readers the first account of certain improvements by Mr. J. Harrison Scott, by which we think all these essential conditions of a thoroughly good pipe joint are at length realized.

The improvements we speak of are variously modified as they relate to Cast Iron Pipes, Wrought Iron Pipes, and Soft Metal Pipes; but they have this general and remarkable characteristic, that every pipe carries, as it were, its own key, by which it can be made fast and unfast at pleasure; the key, too, so inseparable from the pipe that it can never be mislaid—and a key so simple

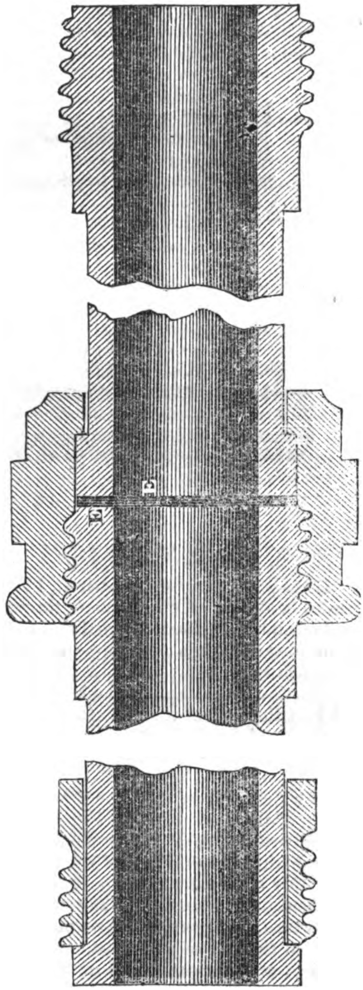
withal that it requires only to be *turned round*.

The following details we extract from the inventor's own specification :—

1. *Cast Iron Pipes.*

"I effect the joinings by means of nuts and screws, but instead of casting the nuts separately from the pipes, as nuts for other purposes are usually manufactured, I cast each length of pipe with a suitable nut, loosely encircling, but inseparable from it, (except by violence) and I cast both the pipe and the nut by one and the same operation. A plain core of loam or sand, or other suitable material, is used for forming the interior of the pipe, which pipe is formed externally (by moulding to pattern in the usual way) with a male-threaded screw piece at one end, and a plain flange at the other. A second core, on which a nut is formed in like manner, is made hollow to allow the first core to pass through it, and large enough to admit the metal to flow through, which forms the exterior of the pipe. On the outer surface of this (second) core there is a male screw thread, moulded of the same depth and pitch as that on the male-screw end of the pipe, so that when the nut is cast upon it there shall be produced on the inside thereof a female screw, exactly corresponding with the male screw. The nut at its least internal diameter is narrower than either of the flanged end pieces of the pipe, so that when cast it cannot be slipped off, either from carelessness or design. After both cores have been prepared, the patterns are removed, and the cores placed within the casting flask or frames, in the manner usually followed in foundries, the inner pipe, or core, being supported and kept firm by screwed wire greins, as they are technically called. The metal is then poured in, and both the pipe and nut cast at one running. When the metal has cooled, the sand, or loam, or other suitable material, is removed, and should the pipe, or nut, present any excrescences arising from bad moulding, faults in the pattern or otherwise, they are removed in the ordinary way by hand tools.

Fig. 1



"In figure 1, I have shown two lengths of pipe of the form and with the appliances aforesaid joined or coupled together (with a washer E between them), from which it will be seen, that the nut encircling each length must always be slipped forward to the plain flanged end of the length of pipe to which it is attached and screwed on to the male-threaded end of the other or adjoining pipe. It will be necessary, of course, that all the lengths of pipe in any series or system of pipes, and all the nuts attached to them, should be cut after the same identical patterns. When it is desired to take out an imperfect or damaged length of pipe, or to insert a new washer in a joint which has become leaky, all that is required is to unwind the couple of nuts by which it is held fast, (by a spanner, wrench or any other suitable lever,) and when the new length of pipe, or new washer has been introduced, the nuts are at hand, requiring only to be brought forward and screwed upon the new or old pipe. The nuts may also be screwed up to any degree of tightness required, and being of the same metal with the pipes themselves they do not

easily relax their hold from the alternate effects of expansion and contraction, so that as long as the washers remain in good order, an occasional tightening of the nuts is all that is needed to keep the joints steam, or water, or even gas and air-tight."

Fig. 2.

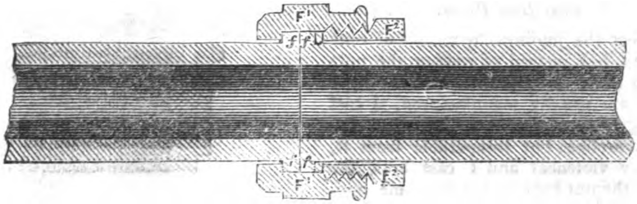
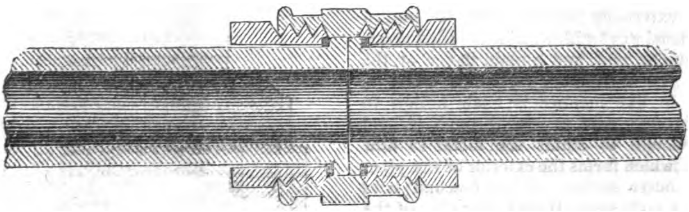


Fig. 3.



2. *Wrought-iron Pipes.*

"If the pipes are of wrought-iron, I cause them to be drawn of one diameter throughout, both internally and externally. I then slip on to each pipe a cast nut and screw-piece, such as are represented by F^1 and F^2, in the sectional view, fig. 2; and having done so, I heat the ends of the pipe, the one after the other, and dropping them upon a round metal stud, the size of the bore of the pipe affixed to some solid hard surface, (the purpose of which stud is to prevent any compression of the pipe inwards,) I produce, by repeatedly raising and letting them fall, or by hammering, flanges, *f*, *f*, of such height, that neither the nut nor screw-piece can pass over them. The joining of any two such pipes is then readily effected, by winding the nut F^1, at the end of one pipe, on to the screw F^2, at the opposite end of the other, interposing, as usual, any suitable soft substance between the ends of the pipes. Or, instead of making each pipe carry a nut and screw-piece, each pipe may carry two screw-pieces, one at each end, as represented in fig. 3, and the joinings be effected by winding a nut upon each couple of opposite screw-pieces."

3. *Soft Metal Pipes.*

"In the case of soft metal pipes, such as lead, I join them with nuts and screws of iron or brass, or any other suitable metal, fitted on to them exactly in the same way as that just described, adding only a thin metal washer, to prevent obtrusion at the end of each soft metal pipe; but the flanges at the end are produced simply by cold hammering or compression."

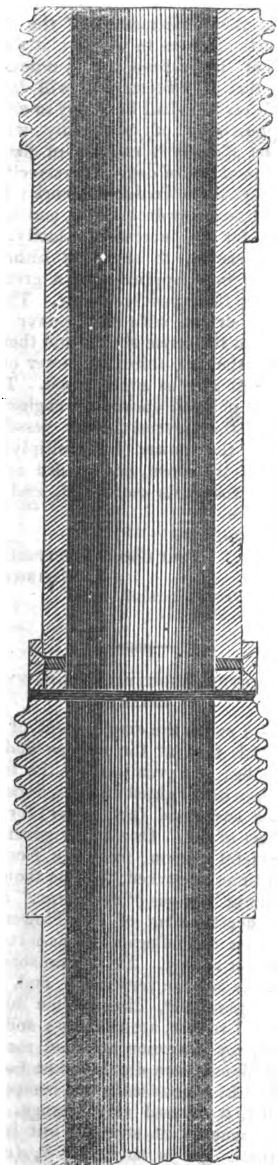
The patentee observes that, instead of producing the flanges by either of the methods before described as applicable to wrought iron and soft metal pipes, metals rings may, in the case of hard metal pipes, be shrunk on to the ends of the pipes, and secured there by screws or rivets, in the manner shown in fig. 4; but that though this is a convenient method to adopt in occasional emergencies, it does not produce so tight a joint as the others, and is not, therefore, to be recommended in preference.

Mr. Scott provides also for the elongation and contraction of his pipes from variations of temperature by the very ingenious and efficient means represented in fig. 5, and which he thus describes,—

"A and B are two pipes. The pipe A is plain at the end where the two pipes meet, with the exception of the projecting pin F, afterwards mentioned; but the corresponding end of the pipe B is made of three diameters, the first, 1, being the same as that of the pipe A, and the two others, 2 and 3, larger, and it terminates externally in a screwed flange C. D is a nut, with internal

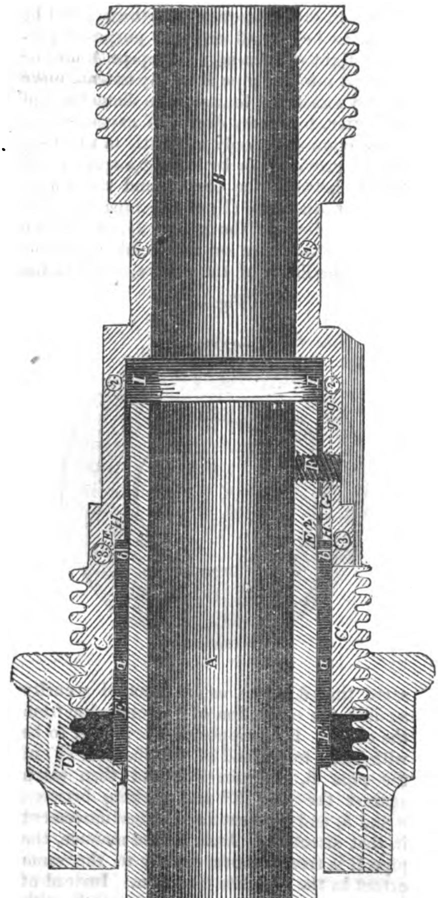
threads to correspond with those of the screwed flange, C. E[1] is a tubular ring, or metal washer, which is passed over the pipe

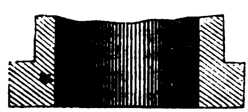
Fig. 4.



A, and pushed forward to the bottom of the nut D. F is a screw pin, tapped into the pipe A, the projecting head of which takes into a groove G, which extends through the whole length of the diameter 2 of the pipe B, as shown in figure 6. The exterior of the pipe A, from *a* to *b*, is wound tightly round with hemp, yarn, (or any other suitable material) to a depth nearly

Fig. 5.

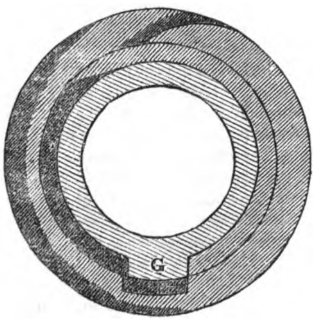




equal to the difference between the diameters, 2 and 3 of the pipe B. A metal ring E² is then passed over the pipe A and brought up against the end *b* of the hemp or other packing just described, so as to be flush with it. The pipe B is next passed over

the pipe A, and its hemp or other packing, and the ring E^2, after which the nut D is wound round the screwed end of C, till the packing from *a* to *b* is strongly compressed between the tubular ring E^1 and ring E^2, as also the shoulder H of the pipe B: a joining is thus formed between the two pipes, which, without interfering with their extension or contraction lengthwise, will be found to be for all ordinary purposes perfectly tight and sound. The pipe A may be inserted into the pipe B to any extent, more or less within the limits of the diameter 2 of the latter, but every degree of expansion or contraction commonly met with in practice, will be provided for by leaving a space equal to I I, between the pipe A and the end of the first diameter (1) of the pipe B. The pin F sliding in the groove G, allows the pipe A to advance or recede to any extent within the limits of the groove, while at the

Fig. 6.



same time it serves as an effectual security against the separation of the one pipe from the other. For, supposing the pipe A to be withdrawn to the end of the diameter (2) of the pipe B, the pin F would then catch against the ring E^2 and packing between *a* and *b*, and prevent any further movement in that direction. And, in like manner, the pipe B is free to move exactly to the same extent in the opposite direction. Instead of one pin, two or more such pins as F, with suitable grooves, may be used where greater security against separation is desired. The arrangements which I have described under this head for providing against this elongation and contraction of tubes from variations of temperature, need of course to be adopted at intervals only, in any series or system of pipes; as, for example, where there are bends or angles, or where the piping has to be carried through walls."

THE "NOVELTY" STEAMER.

Sir,- In looking at your Number of the 14th of January, I find that your correspondent "Sternpost" calls upon me for further information respecting the correctness of the performances of the *Novelty*, and particularly as to whether it was in *the dark* that she realized the 8¼ miles. I beg to say that if "Sternpost" will favour me with his card, I shall be happy to afford him an opportunity of personally witnessing what the *Novelty* is capable of performing in the broad face of day. I perceive "Sternpost" appeals to Tredgold's work; but *that refers to paddle-wheel vessels*, and not *screw* vessels, for an increased velocity. I am sorry, however, to say that hitherto the screw has been applied with a greater loss of power than paddle-wheels. The screw must be driven with the power applied *directly* to the *screw* shaft; and then it will be found that one-third the power of paddle vessels will give as great speed. The employment of such enormous engines as are used in the several screw vessels, and reducing the power by multiplying the motion of the screw, are decided errors, by doubling the coals consumed, and cost of engines, &c.

I am, Sir,
Your obedient servant,
J. WIMSHURST.

2, Cowper court, Cornhill.
Jan. 26, 1843.

GAS-METER ROGUERIES—MR. FLOWER BELIED!

Sir,—I am in the employment of a most respectable firm at the eastern end of the metropolis; our premises, for the last eight years, have been lighted with gas, during which time we have paid (*per meter*) for 48,000 cubic feet of gas. One of my governors, (a very careful person, from the North,) has several times remarked, that he thought our "consumpt" of gas "over large," and seeing an advertisement of Mr. Flower's pamphlet "on the fallacies of gas-meters," he sent me for a copy. He had no sooner read it, than he became very angry, and, handing me the pamphlet, directed me to "read that!" I read it, accordingly; and on the morrow, my governor accosted me with—"Well, Jamie, noo dinna ye ken how we're a' robbed by thae rascally gas companies?" I replied, it seemed very strange. "Ay, mon, ye may ca' it strange, but it's waur than that: go ye to * * * *, (our tinman,) and tell him to mak me a vessel, directly, according to the directions in Mr. Flower's buik, wi' a wee bit o' glass in it." After a good deal of bother with the tinman,

the "*measure*" was completed and proved. Friday last was the day appointed for the trial; and, fearing that Mr. Flower's proffered services might be too expensive for us, we obtained the attendance of a respectable gas-fitter, to make the joints good and to guard against accident. The trial then came off; ten cubic feet—fifteen feet—twenty feet—and thirty feet were successively drawn from the meter, and apparently correctly registered. We went on, however, until we had *measured* fifty-six feet of gas, when the meter registered *fifty-seven*, thereby proving the meter to be "*unfair*" against the consumer, to the extent of "*nearly two per cent.!*" My governor calculated that, taking the error at two per cent., the gas company had, in the course of eight years, cheated him of nearly nine shillings. I respectfully submitted, that Mr. Flower was by far the greater cheat of the two; for, whereas the gas people had only, in eight years, wronged us of nine shillings, Mr. Flower had, in ten days, cheated us of three-and-twenty shillings! The accounts standing thus:—

	£	s.	d.
Dr. the Gas Company—to estimated deficiency on 48,000 cubic feet of gas, at 2 per cent. =1,000 feet	0	9	0

	s.	d.	
Dr. Mr. Flower—To copy of pamphlet	1	0	
Tin measurer, with stop-cocks, union joints, sight-glass, &c.	16	6	
Gas-fitter, making joints, &c.	5	0	
56 feet of gas wasted	0	6	
			£1 3 0

The meter (one of Crosley's 5-light) was not touched previous to the trial: on examination afterwards, the water was found to be slightly above the proper level, and adjusted, and, I dare say, now registers correctly. My governor congratulates himself mightily on the possession of a tolerably "honest meter," after Mr. Flower had frightened him into the firm belief, that these machines were, from their PRINCIPLE, "*incapable of affording just measure.*" Verily—

> "Trifles light as air
> Are to the *suspicious* confirmations strong
> As proofs of Holy Writ."

The foregoing needs no farther comment from,

Sir, yours obediently,

ONE OF THE HUMBUGGED.

Whitechapel, February 6, 1843.

THE ATOMIC AND PHOTIC THEORIES.

Sir,—I hope that you will have the goodness to insert in your valuable Magazine the following remarks on the letter of your correspondent "Cogito."

First, with respect to antagonistic essences. It appears to me that the atomic theory begins on the second step of the ladder of science; the medium in which those atoms are to rest being the first. Now this medium (whatever it may be called) being, in consequence of living action, drawn to and into the earth, with all its atoms separate, is cold, and thus a descending fluid. The atoms and their medium, in a globular state, (say of twelve atoms,) by the action of life forced from the earth, constitute heat, and thus an ascending fluid. And here we find the two antagonistic principles of nature.

In my last letter I explained my views respecting visible and invisible light, *i. e.*, light and darkness. But I must add that, although the visibility of light depends on motion, that motion is not vibratory, but minutely progressive, in the same manner as if a stick were pushed at one end, and, consequently, instantaneous, as electricity.

As your correspondent "Z" remarks, "all material bodies have photic halos of their own, radiating even invisibly and insensibly, '*in darkness as well as in brightness,*' and capable of making impressions upon each other." True, but let me ask what forms these halos? The returns of the photic-traversing-fluids, which, in striking against the objects, take their impressions. The animated body has a halo proceeding from itself, in consequence of its constant change of particles.

Your obedient servant,

EMILY ANNE SHULDHAM.

Norton Fitzwarren, Jan. 19, 1843.

Sir,—With reference to Miss Shuldham's letter, inserted in No. 1015 of your valuable journal, I beg leave to mention that I had not seen or heard anything of her "New Theory of the Universe" before. To judge from what her letter says about it, I think that we differ widely in every respect, except the point, that light is a material fluid. In the *historical* account of similar theories, which I intend shortly to publish, as an introduction to my system of matter, I shall have great pleasure to mention Miss Shuldham's as one of the number.

Requesting you to give a place to these lines in your journal when convenient, I am respectfully, Sir,

Your obedient servant,

Z.

London, January 24, 1843.

THE SELF-REGISTERING BAROMETER, AND READMAN'S IMPROVED BAROMETER.

Sir,—In No. 403 of the *Mechanics' Magazine* (April, 1831) the floating system is described by me: and it is again described, in No. 998, for September last, of your valuable Journal, as forming the chief improvement in the patent improved barometer.

The description of the floating system is contained in an account of the Self-registering Barometer given in No. 403. It is there, in fact, very minutely described. The cause of the account of the construction being so particular was this; that not being able myself to obtain *truly* cylindrical *drawn* glass tubes, I was desirous that the difficulty which might be experienced in procuring tubes of a determinate figure, should not be the means of disappointing any one who might wish to construct such a barometer from that description. Some time previous to April 1831, the instrument, such as it is described in No. 403, was roughly made, and the late Mr. Day, Optician, Poultry, Cheapside, London, permitted it to be placed among his barometers. It was found, I believe, to be as sensible to the changes of the atmosphere as any of the others were. It was also accurate. From the construction of the floating system, the surface of the mercury in it, is absolutely stationary, and one of the scales being measured directly from this surface, is consequently present to test the correctness of the others.

The floating system was again mentioned in No. 654, February, 1836, in the description of an engine that will derive power and motion immediately from the changes that occur in the weight of the atmosphere.

It has frequently happened, I believe, that different persons have thought of similar or identical means to effect the same purpose, each of whom was ignorant at the time of what had been done by the others. It seems very probable, too, that more attention is directed now towards meteorological instruments than they obtained twelve years ago. I apprehend, however, that any one who pleases to construct a self-registering barometer, from the descriptions given in the *Mechanics' Magazine*, April 1831, or February 1836, can do so without infringing on the rights of the patent mentioned at the beginning of this letter.

I remain, Sir, yours truly,

W. M. G.

JEFFREY'S CEMENT.

Sir,—I am not aware that any account has appeared in your Magazine of Jeffrey's marine glue, except the specification of the patent, by which we learn that it is a combination of shell-lac with caoutchouc. Now I cannot comprehend how this composition should be so much more tenacious than shell-lac by itself, and am inclined to believe that had the experiments of which we read in the newspapers been made with simple shell-lac, the results would have been much the same. We all know that shell-lac, as a cement, is very strong. The admixture of melted caoutchouc, or caoutchouc dissolved in turpentine or naphtha, may be supposed to temper the brittleness of the lac; but the toughness thus acquired must be at the expense of the strength of the lac. Nay more, the heat required to melt the composition, which must be brought to the boiling point before it is applied to the substances to be joined together, must apparently have the effect of dissipating the caoutchouc, which goes off with much smoke, and leaves as a residuum, in combination with the lac, a quantity of carbon or charred matter, which apparently can add nothing to the tenacity of the glue, but rather impair its virtues. I write, however, under correction, and should be happy to see the question discussed by some of your competent correspondents. I would only add, that if the glue can be melted and remelted at pleasure, it is evident that the substances joined together would separate if exposed to a degree of heat at which lac is softened; and we know that letters sealed with wax cannot be sent to India without risk of adhering together. Masts or spars, therefore, joined by the patent glue could not, I should imagine, stand the heat of a vertical sun in the East or West Indies. I should have had a higher opinion of the powers of this new glue, if it had appeared that when once set, it could not be again softened. Doubtless the necessary steps have been taken at Woolwich to ascertain the real merits of this invention, and an account of them would be very acceptable to many of your readers besides, Sir,

Your obedient servant,

THOMAS JOINER.

ADELAIDE GALLERY EXPERIMENTS ON THE PASSAGE OF CALORIFIC RAYS.

Sir,—I was present at the Adelaide Gallery on Saturday evening last, and witnessed two experiments performed by one of the lecturers at that institution, to prove the passage of the calorific or heating rays, emitted by a Drummond light, through a large condensing lens.

The *results* of the two experiments were satisfactory enough; not so, however, the *mode* in which they were conducted.

The first experiment consisted in placing one bulb of a Leslie's differential thermometer in the focus of the lens; the result of which, as observed by a gentleman who ex-

amined the instrument before and after the experiment, was quite satisfactory. But I observed that, in handing down the instrument to be inspected, the lecturer (who was evidently *warmed* by his subject) *held the bulb*, which had been exposed to the action of the rays in the focus of the lens, *in his hand*,—the warmth from which would, to say the least, materially affect the thermometer.

The second experiment consisted in igniting phosphorus in the focus of the lens: here, too, the experiment *succeeded*. But I observed that the phosphorus showed no signs of oxidation, no smoking or fuming, *until it had been brought in contact* with and rubbed against an iron ladle, which was held at a short distance behind it. Now it is clear, that ignition *ought* to have occurred when the phosphorus was held *free* in the focus of the lens, isolated from other objects, and exposed also to the rays reverberated from the inside of the iron ladle: and that *contact* with that ladle (provided it were at the ordinary temperature at the commencement of the experiment) *ought* to have retarded the act of ignition, in consequence of the great conductibility of the metal.

Now, sir, as the *results* obtained are contrary to the highest authorities in these matters, and as I had no opportunity of putting any question to the lecturer without rendering myself liable to the charge of unwarrantable interference, I hope he will not refuse to satisfy my scruples as to the above-mentioned experiments, and to inform me *why he held the bulb of the thermometer in his hand*, and *why he rubbed the phosphorus against the iron ladle?*

I am, Sir, yours respectfully,

AN AMATEUR.

GAS METERS; WET *v.* DRY.

Sir,—I know not whether the "dark ages" are about to revisit us; that the period of the crusades has recommenced is quite certain. Several very remarkable crusades are now being carried on; some by companies against individuals — others by individuals against companies. Two of the most remarkable, perhaps, are the crusade against *wooden pavements* by the city "Peter the Great," and other gowned old women, and the crusade against *gas meters*, (alias, gas companies,) by the Flower of Bridewell —precinct. Both these crusades are alike remarkable for the want of sense which distinguishes their advocates. Of the former I shall have somewhat to say hereafter; on the present occasion I wish to say a few words on the gas-meter question, because, having frequently advocated in your pages the supply of gas *by measure only*, I should be open to censure for making such a recommendation, if no correct measurer were to be had.

That many of the gas-meters now in use are defective I know very well, and this, I apprehend, no one who knows anything of the matter will affect to deny. Some of them are of the earliest construction, put up when both gas-lighting and gas-meting was in its infancy; some have become defective from accidental injuries, others from having been repeatedly tampered with; but to say that all are defective to the extent assumed by Mr. Flower, and that "the water meter from its principle is defective, and incapable of affording a just measure of quantity," is an assertion wholly at variance with truth, and a statement the falsehood of which must be known to the party who puts it forth—if he really knows any thing at all of the matter. It is not to be supposed that gas-meters, unlike every other work of man, should arrive at perfection instantaneously; nor is it at all likely that so important a machine as the gas-meter would be wholly neglected in the onward march of improvement. Nor has it; and, as a proof how much ingenuity has been directed to this matter, I would refer to the numerous patents taken out within the last ten years, for improvements either real or fancied. Mr. Flower, in his pamphlet, asks, "If, as the companies construct their meters, that too little water in them will occasion an impossibility of obtaining a supply of gas, why should they not be so gauged as to declare to the consumer, that if he has above a certain quantity of water in his meter, that he is registering water as well as gas?" How comes it that, after "due investigation," Mr. Flower should put forward such a question? Why did he not acquaint himself with what had really been done—and done for a considerable time—in this line of improvement. Mr. Flower tells us that gas-meters have a constant tendency to accumulate water by condensation,—although, when it suits him, it is a loss by evaporation. To counteract this continual inclination to make water, therefore, it is only necessary to provide suitable means of relief from this superabundance of fluids, and the meter will continue in a healthy state. Now, such an arrangement is really provided in Mr. Botten's patent gas-meter, which, in its present highly improved state, I have no hesitation in pronouncing to be as correct and as trustworthy a gas measurer as the ingenuity of man has hitherto produced. With respect to perceptible condensation and evaporation, generally speaking, what Mr. Flower states is sheer nonsense. The assumed periodical evaporation of the water, with the monthly visitations of the inspectors "to replenish,"

are fanciful creations of Mr. Flower's fertile brain, and "airy nothings," to which he has given "a local habitation and a name."

After all that has been said on this subject, I fancy few will deny that, in the gas-meter, we do not look for a *perfect mathematical measurer*, adapted to the niceties of chemical manipulation; all that is wanted is, a JUST MEASURE between man and man, and meters are now made which will measure the gas passed through them *with quite as much accuracy* as ordinary balances will "weigh and measure the various articles that we receive for our household economy!"

Mr. Flower, after railing in good set terms against the water meters, and the companies for using them, when as yet there was no other, proceeds to offer a panacea in the shape of Defries's dry gas-meter. Now, although great ingenuity has been exercised to perfect dry meters, and many advantages would seem to be afforded by their employment, it cannot be concealed that these meters are, as the water meter once was, in their infancy. To what perfection they may hereafter attain no one can foretel; but, at present, no machine of this sort justifies the eulogiums which Mr. Flower has so abundantly lavished upon them. After lauding the dry meter to the skies, Mr. Flower tries, by faint praise, to damn the honest and excellent water meters of Messrs. Mylne and Son, and of Mr. Botten; and, in order to justify his antipathy to the class, he ascribes to the former a liability of accident, (when out of use, mind you,) which practical experience has proved not to exist; while the latter, although "as accurate as it is possible to be," being under the "sinister influence," of the companies, is of no avail!

Mr. Flower elsewhere asserts, that "the gas companies take care that no meter can be used, and therefore made, that will give a maximum of measure." Now, if there was a shadow of truth in this statement of Mr. Flower's, (which there is not)—if this all-powerful and insurmountable *sinister influence* is at work—of what avail is Mr. Flower's suggested remedy? What does it signify to me, whether I employ a *wet* or a *dry* meter, if the "*sinister influence*" that controls these matters will "permit" none to be used that gives a maximum of measure? The superficial critics of the newspaper press seem to have been sadly gulled by the plausible style of Mr. Flower's lachrymose pamphlet; no practical man, however, could for a moment be misled by the highly-coloured statements, the gross exaggerations, or the wilful misrepresentations which he has crowded into sixteen pages. Mr. Flower speaks of "bugbears." I beg leave to tell him, that his pamphlet is one of the greatest "bugbears," and most mischievous "bugbears," that ever issued from the press.

As an instance of the unblushing effrontery and utter disregard of truth with which Mr. Flower puts forth at random any remark that suits his purpose, I would refer to page 80 of your last Number, where Mr. Flower says—"Every body will allow, now, that not half the number of fires happen since the introduction of gas." (Not that any one but Mr. Flower would ever have connected the two things together.) This fearlessly put forth in the face of the positive and well-known *increase* of fires! Hand Mr. Flower the belt!

Mr. Flower's pamphlet has certainly made some stir in the world, but it is a production in no way creditable either to his head or his heart; and I cannot take leave of him better than in his own words — "It is too bad, that a confiding public should be tricked and duped by parties, upon whose honour it places as full reliance, as they do upon its gullibility."

I am, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington,
February 6, 1843.

THE ADELAIDE GALLERY LECTURES ON "THE FALLACIES OF GAS-METERS."—FINALE!

On Saturday evening last Mr. Jones gave a concluding lecture, in which he professed to give "the results" of the various experiments which had been made at this institution to test the accuracy of the water meter as an instrument for measuring the supplies of gas. With these "results" our readers are already acquainted; and it is only necessary, therefore, to notice here that the lecturer omitted in his recapitulation (through mere forgetfulness, of course!) the remarkable "results" of the comparative trial which was made, on the preceding lecture day, between Botten's Improved Water Meter and Defries's Dry Meter. To the objections made by Mr. Wright and Mr. Sharp, to the mode of experimenting by which the alleged "fallacies" had been established, the lecturer made no answer (from forgetfulness also, it is to be presumed). Some persons had said or insinuated that the whole purpose of these lectures had been to cry down the water meters, in order to puff off Mr. Defries's dry meter; but to show the utter groundlessness of this imputation, he concluded with a warm eulogium on Defries's "best!" It was so "simple," so "beautiful," so wondrously exact, that once set agoing correctly, it would continue going correctly as long as the materials of which it is made would last!!!

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1019.] SATURDAY, FEBRUARY 18, 1843. [Price 6*d*.

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street. Double.

MESSRS. PECKSTON AND LE CAPELAIN'S ROTARY DRY METER.

Fig. 1.

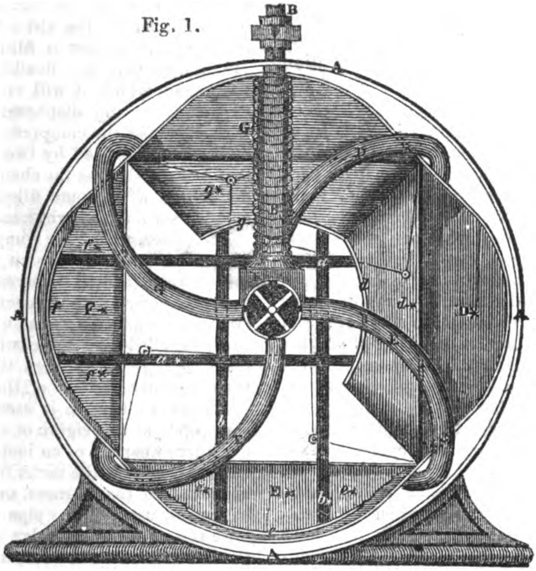
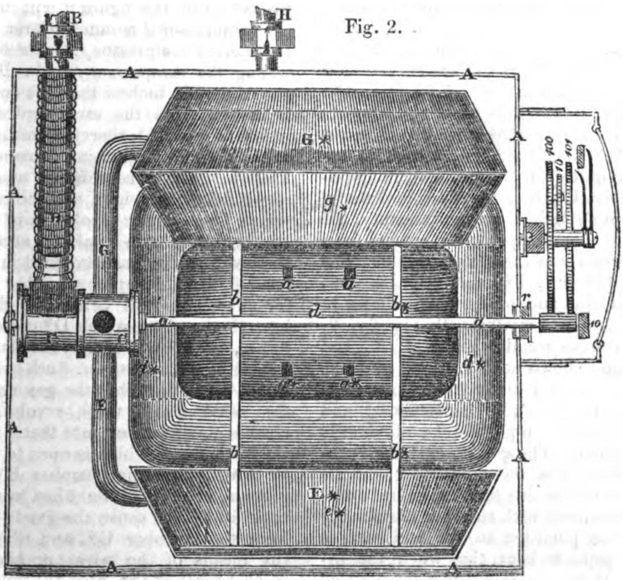


Fig. 2.



MESSRS. PECKSTON AND LE CAPELAIN'S DRY METER.

The engravings on the preceding page represent the Dry Meter of Messrs. Peckston and Le Capelain, referred to by Mr. Wright, in his Lectures at the Westminster Scientific and Literary Institution, (see p. 135,) and spoken of with great approbation. We extract the following description from the specification of the inventors.

"Fig. 1 is a transverse vertical section of our rotary dry gas-meter. A represents the outer case of the meter, which may be constructed of cast-iron, tin, copper, or zink, as most convenient. This being a vertical section of the meter when the end is supposed to be removed, shows the inlet pipe B, the valve C, the hollow clipping-piece I, the pipes D, E, F, and G, leading from the valve to their respective chambers D*, E*, and G*, the compressors *d*, *e*, *f*, and *g*, and the diaphragm, (or flexible membrane,) *d**, *e**, *f**, and *g**, attached to the compressors and chambers. The compressors *d* and *f* are connected together by the strong wires or bars *a a* and *a* a**, and the compressors *e* and *g* by the wires or bars *b b* and *b* b**. The lengths of these wires or bars, respectively, are so adjusted, that when the chamber D*, and the diaphragm *d**, thereunto attached, are quite full of gas, and the opposite chamber F*, and the diaphragm *f**, thereunto attached, are quite empty, the said wires or bars extend from the compressor *d* to the compressor *f*. In like manner, the compressors *e* and *g* are connected together by the strong wires or bars *b b* and *b* b**: the length of those bars or wires, respectively, is so adjusted, that when the chamber G*, and the diaphragm *g**, thereunto attached, are quite full of gas, and the opposite chamber E*, and the flexible material *e**, thereunto attached, are quite empty, the said wires or bars, respectively, extend from the compressor *e* to the compressor *g*. The chambers D*, E*, F*, and G*, are constructed of tin, and of the shape shown in this figure, and longitudinally in fig. 2. The compressors are also made of tin, and of the shape shown at *d*, *e*, *f*, and *g*. The gas enters into this meter by the inlet pipe marked B, the mode of constructing and fixing which inlet pipe will be afterwards fully explained. The gas, on entering is received by slits into the different partitions of the valve C, (in this figure four in number, to correspond with the four chambers,) and over each partition in the said valve is soldered a pipe, so bent, that when the internal part of the meter occupies the position shown in the drawing, the pipe D shall be connected with the chamber (D*), which is directly opposite to the valve C, on the right. In this figure, it is evident that the pipe marked D is the one open to that division of the valve C which communicates with the inlet pipe B, by the slit already noticed; consequently the gas is filling the chamber D*, and causing the flexible membrane *d** to distend, which it will continue to do till that chamber and diaphragm become filled with gas. As the compressor *d* is secured to the diaphragm *d** by two or more rivets, it is evident that, as the chamber D* and the diaphragm *d** become filled with gas, the compressor *d* is brought nearer to the centre of the meter, whilst the compressor *f*, which is secured to the diaphragm *f* f** by two or more rivets, (as will be hereafter described,) being connected with the compressor *d* by the two wires or bars *a a* and *a* a**, causes the gas to be expelled from the chamber F*, and its diaphragm *f* f** through the pipe F, into the lowermost division of the centre revolving valve C, whence it escapes by the slit shown (about one eighth of an inch in width, and three quarters of an inch in length,) into the outer case of the meter from whence it is conveyed to the burners, or where it may have to be used, by the pipe H. If we suppose the centre of the valve to be a fulcrum, (it is the centre round which the different chambers and compressors revolve,) by mere inspection of the figure it will be seen that the compressor *d* is much nearer to the centre than the compressor *f*. (in the figure) Supposing the compressor *f* to be distant from the centre six inches, then the compressor *d* is distant from the same centre only four inches; the weight, therefore, of the compressor at *f* would (supposing there was not any friction,) raise a compressor at *d* of nearly one-third more weight, and the consequence would be a quarter revolution of the chambers; such motion would be accelerated by the levity of the gas contained in the chamber D*, and its diaphragm *d**. This quarter revolution will bring the chamber E* into the position which D* occupies in the figure, and D* will occupy the place there occupied by G*, and so on. Such being the case, it will be evident that the gas entering into the valve, which valve revolves with the chambers, will enter into that part of it by the inlet pipe B which is open to the pipe E, by which pipe the chamber E*, and diaphragm *e* e**, will be filled with gas, and their filling will cause the gas to be expelled from the chamber G*, and diaphragm *g**, (by means of the wires or bars *b b*, and *b* b**,) through the pipe G, and the slit in

the valve C, open from the same division of the valve to the outer case to be conveyed from thence to the burners, by means of the outlet pipe H. So soon as the chamber E*, and its diaphragm e^* e^*, are quite full of gas, the chamber G* and its diaphragm g^* will be quite empty, when, from the reasons already assigned, the chambers will again make one fourth of a revolution, and so on continuously, whilst the gas passes through the meter, as must evidently appear from what has been already stated, and from an inspection of the figure. If, therefore, the chambers be of a specific capacity, and the diaphragms (or flexible membranes) are formed so as to require a definite quantity of gas to distend them fully, an accurate measurement of the quantity of gas passing through the meter, during one revolution, will be ensured. We will suppose, for instance, that each chamber, with the diaphragm thereunto attached, when quite filled with gas, contains one-sixteenth of a cubic foot it follows, that the moveable part of the meter in making one entire revolution must have allowed four sixteenths, or a quarter of a cubic foot of gas to have passed through it. Consequently, if a pinion of ten teeth were fixed upon the axis *a a* (see fig. 2), upon which the chambers revolve, and worked into a wheel of forty teeth, that wheel would make only one revolution, whilst the internal part of the meter revolved four times; therefore one revolution of the wheel of forty teeth would indicate one foot. If we then suppose the pinion of ten teeth (shown in fig. 2) to be fixed upon the axis of the wheel of forty teeth, and that the last-mentioned pinion drives two wheels, one of 100, and the other of 101 teeth, (revolving upon a fixed axis,) it follows that, in one revolution of the wheel of 100 teeth, 10 feet will be registered upon the dial. The axis of the wheel of 100 teeth passes through the axis of the wheel of 101 teeth, and thereon is fixed the pointer, which of course revolves with the 100 teeth wheel. Now as the other wheel has 101 teeth, (it revolves freely upon the axis of the wheel of 100 teeth,) it being driven by the same pinion, it is evident that, when the wheel of 100 teeth has made one revolution, the wheel of 101 teeth will fall one tooth back, or one division on the dial plate; consequently, the pointer, and the wheel of 100 teeth that carries it, make 100 revolutions whilst the wheel of 101 teeth is making one revolution; therefore, one revolution of the 101 tooth-wheel will register 1000, as figured upon the dial plate. If we suppose an opening to be cut through the wheel of 101 teeth, and at the back of that wheel a small ratchet-wheel of ten teeth to be fixed, turning upon an axis attached to the wheel of 100 teeth, a striking-pin at the back of the wheel of 101 teeth will move the said ratchet-wheel one tooth, in one entire revolution of the wheel of 101 teeth, and thus indicate 1000, 2000, 3000, &c., to 10,000.

"It has already been mentioned that the chambers and diaphragms should all be made of precisely the same capacity for one size of meter; that is to say, of one specific size for a three-light meter, of another specific size for a five-light meter, another specific size for a ten-light meter, and so on, increasing in size as the size of the meter increases. In order that there may be no variation in size (for any one specific size of meter,) the best way will be to prepare blocks of wood, shaped exactly to the form of the chambers used in the meter for which the diaphragm (or flexible membrane) is required upon which the leathers are to be stretched and secured down by packthread, or otherwise, in a groove made in the block for the purpose, in order that the leathers may be brought to, and retain the exact form that is required. It will be necessary in most cases to soften the leather with a little olive oil, prior to its being stretched upon the blocks, and whilst upon them, it should be dressed with olive oil and a small portion of tallow to prevent the action of the gas thereon, and also to render it perfectly gas-tight. When the flexible membranes (or diaphragms), which may be made of fine calf skin, of lamb's seconds leather, or of roan, are formed into shape and prepared as above described, the compressors are secured to them by rivets; in most cases two rivets will be sufficient for one compressor. These rivets should be made with broad and flat heads, and under each head should be placed a leather collar of somewhat larger size than the head of the rivet. The rivets then passing through the diaphragm (or flexible membrane) are secured to the compressor by riveting in the usual way. The leather collars put under the heads of the rivets, are for preventing the diaphragm from being cut or injured by the operation of riveting. When the compressors have been attached to the diaphragms in the way as above described, each diaphragm has to be attached to its respective chamber, so that the junction between the chamber and diaphragm shall be perfectly gas-tight. This is effected by turning over the edge of the chamber, so as to form a groove of about $\frac{3}{16}$ths of an inch in depth, into which groove, the edge of the diaphragm is to be carefully inserted; the tin is then to be flattened down with a small wooden mallet (securing the diaphragm in the first instance, at four or more equidistant points,) and when the tin is uniformly flattened

down, so as to close up the groove entirely, the junction between the diaphragm and the chamber will be perfectly gas-tight. The rods, or wires, *a a*, *a* a**, *b b*, *b* b**, are secured to their respective compressors, by means of soldering.

Fig. 2 is a vertical and longitudinal section of the rotary dry gas-meter, in which the parts corresponding with those already described in fig. 1, are marked with the same letters of reference; consequently, so far, further explanation is not required. In this figure, however, is shown the axis *a a*, made of strong brass, or iron wire, the brass bosses through which the axis passes, a small stuffing-box at *r*, the axis carrying a wheel, or pinion, to drive the counting or registering index, and the outlet pipe H, with its union. The train of wheel work, shown in this figure, forming the counting machine and its operation, were fully described when explaining fig. 1.

THE SOUTH SHIELDS REPORT ON ACCIDENTS IN COAL MINES.—CONCLUDING NOTICE.

In addition to Ventilation of the pits by the plan proposed by Mr. Gurney, the Committee strongly recommend the adoption of the Staffordshire system of draining off the deleterious gas by "topheads," originally devised by the ingenious, and as yet, but poorly requited, Mr. Ryan, and more than once very fully explained in our pages. (See *Mech. Mag.* vols. 24 and 25.)

"The plan of exhausting the gas by drifts driven along the face of dykes which are found to draw back and accumulate the gas in great abundance, and perhaps aid in creating it, and which has flowed up through the natural divisions of the *coal*, *backs*, *shires* or *cleavages*, is deserving of extensive application. The support which the natural position and dip of coal seams, their structure and their interruptions, and by faults, or dykes, give to the suggestion of draining by gas drifts scientifically applied, borne out by extensive practical demonstration of its great utility in Warwickshire and Staffordshire, and partially in some instances in the Northumberland and Durham districts, leaves no doubt of the important advantages derivable from it, and which are the more valuable, as no interruption of the slightest kind to the present mode of operating in mines, and but small increased expense will arise from its introduction."—p. 75.

In proof of the tendency of the gas to force its way upwards to the dykes through the cleavages in the coal, the Committee cite a remarkable instance furnished by Mr. T. J. Taylor, of Earsdon, where the pressure of an accumulated body of gas amounted to 4⅛th atmospheres or the full power of steam employed in a high-pressure steam-engine.

"This occurred at a water blast in Percy Main Colliery, in 1840, and Mr. Taylor calculated it discharged 12,686,000 cubic feet of gas in sixty-eight hours."—p. 51.

The "partial use in the Northumberland and Durham districts" alluded to by the Committee, in a preceding extract is elsewhere stated to consist merely in pushing on leading drifts before the working part of a mine to test its condition, which drifts serve "to a certain extent to sap and drain the gas in their immediate locality." But the Committee are of opinion, that were the same money which these imperfect drifts cost, "judiciously applied to form a drift along the face of a fault intersecting *backs*, and opening into it lines of blowers, it would drain to an incalculable extent the whole underlaying coal."

All-sufficient as Ventilation is considered by the Committee to be, they do not recommend that it should be relied on to the exclusion of all other remedial means. Although the "Davy" has been shown to be worse than useless, there are other scientific instruments, which, "if commonly employed and correctly observed," would, in the judgment of the Committee, "give such clear and unerring intimation of coming danger from discharges of gas, that ***nothing but the most criminal neglect*** could bring on such fearful catastrophes." Foremost among these instruments, they rank the *barometer* and *sympiesometer*.

"The slightest change in the pressure of the atmosphere is immediately indicated by the gas tubes of the coal: every pore, crevice, and blower, is a natural sympiesometer that is immediately affected by it. When the pressure is decreased, say 1 inch by the barometer, or nearly ½ lb. pressure taken from every square inch, it enables the gas which is surcharged in every space of the coal to pour out in great quantities. But should the atmosphere fall to a very low range, and remove the weight of upwards of 1 lb. from each square inch, then the elastic gas which

has been generating under that pressure rushes into the mine, sometimes in such force and quantities as to foul every passage up to the very shafts in a few hours. When the atmosphere returns to its former condition, the gas is once more pressed back and is condensed in its recesses; and if the change occur rapidly, a perceptible rush and sound of the air into them on its return may be observed. *The barometer is an infallible indication of the gaseous state of the mine:* yet with one honourable exception, that of Wallsend, no mine that the Committee have visited had for the use of its officers such an instrument."—p. 53.

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"The sympiesometer, from its delicacy and susceptibility to changes in the atmospheric pressure—*preceding the barometer commonly from four to five hours in its indications*—and having an elastic fluid similar to that of the mine for its source of action, seems peculiarly fitted for the purpose of an indicator of danger in the mine. It is, besides, less easily injured, and may, if required, be removed from place to place without chance of derangement: and the mercurial barometer, less sensitive than the gas, only demonstrates the escape of the carburetted hydrogen a short time previous to, or at the moment when the mine has fouled and the danger arrived, perhaps, in some instances too late to adopt the necessary precautions."—p. 55.

The *thermometer* furnishes indications scarcely inferior in value to those of the barometer and sympiesometer.

"The effects of the fall of the atmosphere, as described, are much increased by an increase of the temperature, and certain directions of the winds: and what is extraordinary, in the northern hemisphere these favourable meteorological circumstances for the escape of gas are frequent coincidences. When the barometer indicates a fall, the thermometer indicates a rise, and the wind blows from the E., S.E., or S., an ordinary fiery mine will be certain to pass rapidly into a state of great danger. It has, indeed, been commonly observed by the miners that their pits are always most dangerous in *S.E. and S. winds;* but the winds are only natural indicators of the state of the barometer and thermometer, although not always; the instruments most frequently preindicate the winds, for it is *then* the thermometer anticipates them and rises by the increasing temperature and the barometer falls by the decreasing pressure."—p. 53.

An *anemometer*, to measure the rate of the currents of air in the pits, is also considered essential. The only instrument (if instrument it can be called) at present used for the purpose, is a thin hoop or piece of wood suspended by a string, by the degree of deviation of which from the perpendicular the miners judge of the rate of the current in the air passages. The anemometers of Professor Whewell and Mr. Osler are both objected to by the Committee, as "too delicate and performing (*quoad hoc*) unnecessary operations;" but they describe one invented by a practical miner, which seems to be all that can be desired.

"An anemometer, constructed by Mr. Thomas Elliott, in 1835, when an overman at Pensher Colliery, met so strongly with the approval of the coal owners, that in that year, at their meeting in Newcastle, they presented him with 10 guineas for his invention, *but did not adopt it in one of their mines.* The Committee are now in possession of the original, which has never been copied, although its utility is undoubted. They have tried it in the mines with satisfactory results, and can recommend it as a sure instrument, well adapted for its useful object. The inventor thus describes it:—'The works are enclosed within a case 12 inches high, 12 inches broad, and 4½ inches thick, with an oval top, and a ring to carry it by, from one part of the pit to another; on the dial of this instrument, which is moved by the air acting on four wands, similar to a wind-mill, two concentric circles are described. The inner circle is divided into 48, and the outer into 60 equal parts. It has two indices or pointers, whose axes of motion are the centres of their circles, exactly like the hands of a clock: the one, A, points to the outer circle, and the other, B, points to the inner circle. The angular velocity of A to that of B is as 2,880 to 1. Hence, for every complete revolution of B, A makes 2,880 revolutions, and for every 60 revolutions of A, B passes over one of the equal parts into which the inner circle is divided. I have constructed a table (from some hundreds of experiments), by means of which, and the instrument, the velocity of air in a mine may be found with the greatest ease and despatch, and also the progress the slow or registering pointer will make in any given time, and at any rate at which the air may travel.'—A table is then given. An advantage this instrument possesses is, registering the rate *in the absence of the viewer.* for one or two days, as well as indicating the velocity of the then present current."—p. 56.

Another instrument which the Committee

point out as of valuable application to mines, is the *eudiometer* for ascertaining the purity of the air.

"It would not only enable the officer to discover in any part of the workings, at any time, the quantity of oxygen, but also the percentage of carburetted hydrogen or other gases, without which their proportion and state of dilution by atmospheric air from ventilation, and the consequent safety of the mine, is mere guess work, except from the uncertain hint at the flame of a light."

We not only agree with the Committee in thinking that no colliery can be considered as "well regulated" which is unprovided with these various instrumental safeguards; but we would have every coal owner compelled by law to provide them, and inspectors appointed to see that a proper use is made of them. How much in this way is to be expected from the spontaneous benevolence of the coal owners, may be judged of by the fact, that the Committee can cite but one instance where such instruments are in use. It cannot be said here, as in the case of the shaft-sinking, that *the expense* is any objection; no, the real and only obstacle to be got over in this case is a most callous and culpable indifference.

The *employment of boys* of very tender age, to take charge of the trap-doors, the Committee consider to have been a fertile source of accidents. One case is mentioned, in which 34 persons were "killed at a blow," through a boy of *eight years of age* "leaving open a trap-door that had been entrusted to his charge, by which the ventilation was interrupted, and the gas accumulated and exploded;" and another, in which, from a similar piece of neglect in a boy nine years old, thirty-two persons were killed. The Committee recommend that careful, steady, and experienced old men, unfitted for active labour, should be invariably employed in the charge of all *important* doors; and that boys should not be employed in mines, at work of any sort, under twelve years of age—which is two more than the minimum period introduced by Lord Ashley's Act of the last session of Parliament.

The want of "*Registered Plans and Sections*" is another defect in British mining, which is stated to have led to more than one fatal accident. Twice in the Tyne district have the workings of old mines been penetrated, and upwards of 80 lives sacrificed by inundation. Every mining country of Europe possesses a means of ascertaining the condition, extent, and progress of its mines and mineral resources, except Great Britain, the most important of them all. The Committee's remedy is, that the chief officer of each mine, in every district of Great Britain, should be bound to transmit to the Custos, or some similar officer, of each county, correct plans and sections of the mine under his charge, with periodical accounts of the progress of the workings; and that these documents should be open, at all reasonable times, for inspection or copying, by the proprietors or other interested parties. We do not find, as we expected, under this head, any notice of the excellent system of underground mapping introduced by Mr. Sopwith, and are at a loss to account for the omission.

Ignorance of scientific matters among the officers of mines, (generally,) is dwelt upon with much earnestness, as a great obstacle to the adoption of necessary reforms, and to the full development of our mineral resources.

"In their daily application of the great modern-discovered power with the most gigantic engines of Britain, they are ignorant of steam, mechanics, and mathematics: opposed, and sometimes defeated by the pressure and force of water, they know nothing of hydrostatics or hydraulics: their profession consisting of the extraction of minerals, they are unacquainted with mineralogy, metallurgy, or geology: existing by the correct operation of currents of air, they scarce have heard of pneumatics: and, standing continually within the range of a vast laboratory of nature, whose operations are daily producing death, they still continue ignorant of chemistry."—p. 62.

The French School of Mines is cited, as furnishing a striking example of the benefit which such an institution is calculated to confer on mining interests. Even Egypt, scarcely yet awake from her long sleep of desolation, has already her Polytechnic School, with its mineralogical and mining

departments; "while Christian England, at the head of the civilization of the world, her material interests bound up in her scientific knowledge, cannot boast of a single institution competent for such objects." The praiseworthy attempt lately made to found a Mining School in Cornwall, by Sir Charles Lemon, to which he nobly offered to contribute the munificent sum of 10,500*l.*, besides a site for a building; and its failure, through the opposition of a majority of the mining adventurers, are mentioned in terms of deep regret. The University of Durham is referred to, as an institution already existing in the very centre of the great coal mining district, "with (educational) machinery in operation, which, by being somewhat extended, would fully accomplish, if legally sustained," nearly all that is wanted. To this modern institution belongs the honour of having been the first academical body in the kingdom to establish a class of civil engineering and mining—an example since promptly followed by the London University College and King's College. From the following interesting and highly satisfactory account of the course of study pursued at this University, by the students in civil engineering and mining, furnished to the Committee by Professor Chevallier, the reader will see that there is not much to be done, to render it as good a school of mining—for the northern parts of England, at least—as can be desired.

"By the regulations of the University, Title vii., *persons who are not members of the University are admissible, with the approbation of the Warden, to attend any course of public lectures.* In addition to the theoretical instruction, the students are constantly engaged in the practical drawing of plans and machinery, and in levelling and surveying, under the superintendence of a competent instructor. *They avail themselves of the facilities afforded by their neighbourhood, to obtain an insight into the mode of working coal-pits, and to conduct underground surveying.* They visit, also, under proper inspection, the principal public works, manufactures of machinery, iron-works, &c., in the vicinity, and are required, on such occasions, to deliver written reports. Proficiency in those branches of practical work is encouraged by prizes devoted to that particular purpose. It will thus be seen, that the course of study already established, for students in civil engineering and mining, requires but little modification and extension, in order to meet the views of the Committee for the investigation of accidents in mines. *The principal addition required appears to be, a professorship of practical engineering and mining, with an endowment sufficient to ensure the services of a person of experience and high scientific character.*"—p. 65.

Were practical mining professorships, such as this, established—one at Durham, for the northern parts of the kingdom, and another in some "convenient locality," for the mineral districts of Cornwall and Wales—the Committee think that, with the help of such instruction as has been always to be had at the older universities and colleges, we might then contrive to get on very well. Here, however, we come upon plans and propositions which are surprisingly at variance with the sound practical sense which distinguishes the rest of the Committee's Report, and against which we must enter our humble but most earnest protest. They propose that a law shall be passed making it *illegal* to employ any person as a viewer, or under-viewer, who has not studied under one of these practical mining professors, and had a collegiate education besides!!!

"For practising the profession of an engineer of mines, the Committee deem it necessary that a sufficient course of *mathematics and practical surveying, mechanics, hydrostatics and hydraulics, pneumatics, chemistry, mineralogy, metallurgy, and geology*, should be received AT ANY OF THE UNIVERSITIES, from which should be obtained certificates thereof, before the admittance of the aspirant for the completion of his professional education, by a course of *practical engineering and mining at the University of Durham* [or at the contemplated institution for Cornwall and Wales?], whose certificate should be *imperative*, before permission to assume this responsible situation be accorded."—p. 65.

We are by no means sure that so complete a course of scientific instruction as is here chalked out is at all necessary to qualify a person to be a good viewer or under-viewer of mines, and should not be without a strong apprehension of its producing a class of men rather *above* than *equal to* their intended

stations in life; but of this we are quite certain, that, be the amount of knowledge required of aspirants to these offices what it may, it ought to be enough that they actually possess it, *no matter how or where acquired*. To certificates of qualification we have no objection; but they should be certificates of some commission appointed for this special purpose, and granted *to all comers*.

A "*Government Inspection of Mines*" is next recommended, but of a modified character, similar to that established in the case of railways.

"For the effecting of a proper government supervision, all that would seem necessary are two or three qualified practical inspectors, to pay frequent visits to the different mining districts, and descending the mines to examine them and make such suggestions as they may deem important or essential; and the directors of the colliery failing or refusing their adoption, then the whole matter to be referred to the government, or other competent authority or court, who, on hearing the merits of the question, should have power to order, under a penalty, their complete or modified execution. Such inspecting officers would aid greatly in bringing the whole mining system, with the co-operation of the better education of the young mining officers, into the best condition that the peculiarities of the various districts are capable of receiving; and so the country and humanity would be largely benefited by the results."—p. 69.

The Committee conclude with a chapter on "*Medical Treatment after Explosion.*" We did not expect to find so much occasion for enquiry on this head, as this part of the Report discloses. The false views and erroneous practices which prevail among the medical practitioners of the mining districts, are but little in accordance with the highly improved state of the medical art in other quarters. The Committee give at length a very able communication, by Professor Christison, on the nature of the deleterious gases of mines, and the French official rules for the treatment of sufferers from explosion —which last we could not, perhaps, do better than adopt in our mining districts.

PROGRESS OF FOREIGN SCIENCE.

Steam Boiler Explosions.

An elaborate article on this subject has recently appeared in a new Flemish journal, published by M. Jobard, director of the Industrial Museum at Brussels, from whose pen also is the article in question; which has had its origin in the occurrence of a frightful accident from explosion of the boiler of a high-pressure engine at a distillery at Vieux Waleffe, in Belgium, which levelled a large portion of the buildings, and cut through others, leaving a track of desolation such as would have resulted from the firing of a mine beneath the premises.

Perhaps there are few branches of steam-engineering, upon which more has been said than upon this—much to the purpose, and by men well qualified to judge—but much also by persons, more or less devoid of that extended acquaintance with physics and mechanics, and that exact and patient habit of induction and deduction, which are requisite to unravel the truth out of the tangled and distracting details of each catastrophe as it occurs; and, who, without opportunity of personal scrutiny, should possess these qualifications in a still higher degree, to enable them to approach more exact and generalized knowledge of steam boiler explosions than we possess, by discussion of the observations and frequently vague and contradictory accounts of others. Accordingly, Arago, Perkins, Marestier, Seguier, Parkes, Combes, Schafhautel, and a host of minor names, have come before the public on this subject; and yet it must be confessed that, at the present hour, the opinions of engineers greatly differ, and are wholly undecided as to several of the supposed causes of explosions, as well as upon what is the prevailing cause, and what may be the best remedies.

That, speaking very generally, want of skill in original construction upon known and acknowledged principles, and want of sound workmanship and materials, are the principal causes of boiler explosions, there can be no doubt. When we just consider the fact, that with our own British steam-power on land and sea, perhaps four or five-fold that of all the world besides, we have not as many explosions in the year by a great dis-

proportion as they have in America, or even in France and Belgium, where the legislatures have stepped in and prescribed various modes, according to which boilers shall be constructed and worked, and overlooked them by domiciliary visits of appointed special officers—it can scarcely be doubted that the great difference in our favour must arise from our better materials and better constructed engines and boilers, and from the greater familiarity of even our lowest stokers with the machines they work, than is found abroad; and also, from our general preference of the condensing to the high-pressure engine, at least, for navigation.

Yet, where are more gigantic high-pressure boilers to be found than those of the Cornish Expansive Pumping Engines, working generally at from three to four atmospheres above the barometer pressure? But here the principle of slow firing, which precludes sudden and dangerous surcharges of steam, is their safety. Let a Cornish boiler be worked with fir logs, as in America, and the results would soon be sadly different.

The whole of the causes of explosion, which have been from time to time stated, may be classed themselves under two general heads: 1st, they have either arisen from the excessive pressure of surcharged steam; or, 2nd, they have taken place through some supposed decomposition going on within the boiler, generating an explosive mixture of gases, which on ignition has produced the accident. Again, the former class has been divided into those arising from the gradual accumulation of steam pressure, where no means of escape has been afforded to the pent-up vapour, until the boiler has riven, and into those supposed to arise from a sudden and almost explosive generation of steam, instantly bringing up the pressure and volume of steam generated beyond the control of the safety valve, and hence again explosion.

In accounting for all these—in showing how safety-valves may and do stick, —how *electricity* may gag them down—how soft and hard boiler sediments may cause sudden exposure of red-hot surfaces of plates to the water—how water boiling low, and waving up the sides—how sudden sinking in the internally convex bottoms of wagon-boilers, at a red heat, may do the same—how gauge-cocks become useless, and feed-pumps fail; and in devising and proposing remedies, or assumed ones, for all these real, and (many of them most) improbable evils, philosophers, engineers, legislators, amateurs, chemists, and smoke-doctors, (chemical and mechanical,) have jostled one another, and long amused, but little benefited the public.

While, however, so much has been said and written on this first class of our explosions, very little, in comparison, has been brought forward relating to the second; or those supposed to be attributable to the ignition of inflammable gases: and what little has been said, has always hitherto been dismissed without much examination by men of any pretensions to exact science, upon one obvious and simpler ground. It has been said—granting that water is decomposed by iron at temperatures much below visible redness, and that a boiler becomes filled with the hydrogen so evolved, it is equally true the oxygen of the water has been, by the premises, absorbed by the water; and hence, although an inflammable gas is present, an *explosive* one is not. Further, it has been said, evidence is yet wanting that iron will decompose water at any temperature below a bright red or rather yellow heat. These views, in all their collateral circumstances, have been discussed by Baron Seguier, in the Annuaire of 1830. He has shown that the small quantity of air evolved by the water pumped into the boiler, and which goes out again into the cylinder with the steam, will be insufficient to answer the question, and up to a very recent period the question has remained unanswered, if it even be so now.

The Memoir, which forms the subject of this article, is the production of a man obviously fully acquainted with the history of his subject, and not destitute of proper *vigour* of investigation; and if he has not answered fully the question above, he certainly has thrown additional light upon it of a very important kind. The whole paper would be worthy of translation and perusal, as a good *precis* of all, or all that is important nearly on the subject. The chief result and novelty brought forward, however, is thus stated in the author's words:—

"*Principal Cause of the Explosion of Boilers.*

"When the feed-pump ceases to

supply water (the engine being at work) it may *still pump air*, and when thus at any time the boiler ceases to be supplied with water, and its sides become heated by the flame, they decompose the vapour of water present, the oxygen of which unites to the iron, while the hydrogen, *mixing with the air thus introduced*, produces an explosive mixture more or less complete, which takes fire at the red-hot sides of the boiler, or by means of an electric spark occasioned by the raising of the safety valve, which acts the part of an electrophorus, in this case."

Now, here a sufficient cause is undoubtedly found for the introduction of air. We all know that, from various causes, feed-pumps sometimes cease to pump water, yet still continue to act as condensing syringes for air. This is always partially the case, when the water-feed of a high-pressure boiler is regulated by a cock in the suction-pipe of the feed-pump, as is very common in the North of England. Whenever the plunger gland is ill stuffed, and the cock nearly closed, some air will be drawn into the pump at each stroke; and part of this pumped into the boiler, if it do not escape back through the gland.

But a more general case is, that the supply of water to the feed-pump fails, and the pump still in good order, continues to pump air, or a leakage may exist in the suction pipe, if the cock above spoken of is leaky.

It is not to be concealed that the cock in the feed-pump suction, being nearly closed, *infers* that the boiler is fully supplied; but it often occurs, that the feed is regulated by the stoker's hand and not by the float. This much, however, is certain, that the feed-pump being out of order, and the water being low in the boiler, are necessarily connected, and hence, that the pumps delivering air in place of water, at the time that the water becomes low, are circumstances probably of co-existent contingency.

If we grant this, it remains to be considered how far three other conditions will admit of our author's solution. 1. Will an explosive mixture of air and hydrogen remain explosive when mixed with a large proportion of undecomposed steam? 2. How much air is the minimum that will cause explosion? 3. Will any degree of heat to which the boiler sides are ever in reality exposed be sufficient to cause ignition?

As to the first, the writer was long amongst those who utterly disbelieved the fact that steam was ever decomposed within the sides of a boiler. He doubted it, arguing from the conditions requisite to decompose water, when passed drop by drop through a red-hot gun-barrel, as well known to chemists. Here it is certain a very bright red heat, or rather a yellow heat, is necessary; and even when water is decomposed by red-hot charcoal, or coke, a white heat is required: this may be familiarly seen at any foundry; on raking out the cupola, after the day's work, water is thrown on the cokes to quench them; on its contact with the white hot, or rather *blue hot* cokes, a vast volume of flame of liberated hydrogen is instantly produced; but the moment they have fallen below the white heat, all decomposition of the water ceases, and steam alone is generated, or, if hydrogen is produced, it ceases to inflame.

Such, however, does not seem to be the case, where a considerable volume of steam, *under pressure*, and at a high temperature, is exposed for a length of time to contact with a surface of iron, heated even to a very moderate degree. When the temperature of the latter does not even reach redness visible in daylight, decomposition appears, beyond doubt, slowly to proceed.

The conditions, it is to be remarked, are different from those previously stated. Here we have water not as a fluid, carrying off a large quantity of heat in a latent form from the surfaces on which it falls at the moment of decomposition, but water already in the state of vapour, in its state of greatest division; it is not *simply* in contact, under the atmospheric pressure, but it is forced into contact with the iron of the boiler, under a pressure of perhaps several atmospheres. The steam *itself* is at a high temperature, as well as the decomposing surface of iron. Whether that peculiar *description* of molecular action, known to French physicians under the name of "cementation," may here have place or not—whether any *small portion* of the steam once decomposed, (whether by the action of the iron alone, or aided by any reaction introduced by the mixed atmospheric air,) acts as a carrying agent in promoting the decomposition of the remainder,

in the same way as the particles of carbon are carried by those of the iron, from the outside to the inside of the still solid bar of iron during its cementation into steel—is a question we have as yet no means of answering; but it is no longer a matter of doubt, that water in the state of steam is, under such circumstances, decomposed. Of this we will adduce one or two instances.

In the small high pressure steam-pipes, or hot water pipes, as they are misnamed, of Perkins's system, inflammable gases had been repeatedly observed to issue from the screw plug at the upper part of the apparatus, when it was replenished with water: on its removal, indeed, the need of such occasional replenishment, where there was no leakage of steam, might have raised the question of what became of the water? But when a year or two since one or more warehouses, and the Museum at Manchester, were either set fire to, or in danger of it, by these said pipes, and an enquiry was instituted, and certain experiments conducted by, the writer believes, a Mr. Davies, of Manchester, he found that in all cases the water or stream, or both, in these pipes was decomposed, and an inflammable gas produced. The temperature of the surface of the pipes appears to have rather exceeded the melting point of lead.

Mr. Goldsworthy Gurney has related similar circumstances as to a high-pressure boiler in actual use.

In February, 1837, a boiler belonging to Mr. Samuel Stock and Son, at Heaton Norris, near Manchester, was emptied by blowing off over night; the main lid was removed next day, and a man attempted to enter with a candle, when a violent explosion is stated to have taken place, and the man was killed. The boiler was found dry and cold. This is related by Mr. Parkes, who adds, that the air had entered and diffused with the hydrogen through the blow-off cock, which was left open.

A similar case occurred at the sugar-house of Rhodes and Son, in London; and about two years ago the writer himself witnessed a similar fact in the case of a high-pressure boiler, of the locomotive construction, with iron shell and brass tubes. The water got low, and was first perceived by the solder (plumber's solder) beginning to melt off in large quantities. About twenty feet of copper steam-pipe attached to the boiler, and the piston rods of the engines becoming blue, the engines were stopped, and the stoker very discreetly drew the fire instantly. The vapour which escaped at the gauge cocks was nearly colourless, slightly brownish, from the pressure of charred organic matter, and smelt of impure hydrogen; it was not explosive, but was inflammable. The feed pumps had been working right, and the water was at its proper level, a few minutes before: when the boiler had cooled, it was opened, and two rows of tubes and the whole top of the interior fire-box, were bare of water, but no part of the boiler had been red hot except the brass tubes.

These facts are sufficient to prove that an inflammable gas is produced in the conditions to which boilers are sometimes reduced. The question is, will it be inflammable or explosive when mixed with a certain volume of steam? Upon this head we have no very decisive experiments, or at least such as can be reposed upon.

Dr. Schafhautel (Trans. Ins. C. E., vol. 3, part 5) states, that he has found by experiment that the explosive mixture of one volume of hydrogen and two volumes of air was no longer explosive when mixed with *seven-tenths* of its own volume of steam; that is, a little more than $\frac{3}{10}$ths of the mixed gases in a given volume of steam will be explosive. If these statements are to be relied upon, there is ample range for explosion in practice.

The next question is, what is the quantity of air that must be supplied before an explosive mixture will be generated in the boiler? Here we are most in the dark.

Two volumes of hydrogen and one of oxygen, or between two and three volumes of atmospheric air, are requisite for perfect combustion with detonation; but explosion will take place, even at common temperatures, at much below this quantity of oxygen or air; and when both gases are at a temperature of probably from 300° to 600° Fah., explosion would probably take place with even less air than at common temperatures.

Pure hydrogen, which we may assume practically to be that now in question, will probably not fully follow the law of fire damp in this respect. As to the latter, Davy found that the limits of explosion

were between five and fourteen parts of air to one of gas, and that the most explosive mixture was seven or eight parts of air to one of gas. He also found that the explosive mixture of fire damp and common air, at maximum was only about *one-tenth* as powerful as that of pure hydrogen and air, and the latter is what is produced in boilers. Further experiments alone, therefore, attending to all the conditions, can decide what are the limits to the quantity of air necessary to be introduced to produce an explosive mixture; upon this quantity the *chances* of its production by our author's "cause assigned," will depend. It should also be mentioned, that Davy found that one part in seven of azote or carbonic acid prevented the detonation of these mixed gases. The last question then is, will the temperature to which the plates of a boiler are ever likely to be exposed in practice, be sufficient to cause ignition?

In this, as in the former case, we want direct and careful experiments, giving heed to *all* the *conditions* of the question. It may be observed, however, that hydrogen and oxygen will begin to unite silently at a temperature so low as 660° Fahr., if sharp fragments of glass, or any other foreign body, be present; and that the presence of clean metals has a powerful effect in lowering the temperature at which explosion may take place. Hydrogen, at common temperatures, is ignited by a glass rod at a low red heat, and at a lower temperature by a metallic one; and it seems quite likely that, if under pressure, and the gas itself heated highly, it would kindle at a much lower temperature still: the same will apply to its mixture with air *pro tanto*. Boiler-plates are every day heated to a pretty bright cherry-red, even on board steam-boats, as the "coming down" of the fire-places sufficiently shows. Hence, although exact information, to be had by exact experiments, is most desirable, there can be little doubt that circumstances may and do aim to sustain the hypothesis of M. Jobard; and that we are justified in concluding that, amongst the *veræ causæ* of boiler explosions, henceforth may certainly be reckoned that which he has apparently been the first prominently to point out, viz., the contemporaneous decomposition of steam or water in the boiler, and introduction of air to its interior. That this however can be but a rare and occasional cause of explosion there can be no doubt; and therefore his conclusion that this is the *principal* cause cannot be admitted: indeed, in Great Britain it is probably a case of the extremest rarity, from the causes before assigned for the general infrequency of our explosions.

The grand and principal cause, which must press upon the mind of every practical engineer, lies in the rupture of the boiler, by the simple accumulation of mere steam pressure with greater or less rapidity; and this may arise from a great number of contingencies. The most usual are —forcing boilers of inadequate size, by rapid and intense firing, that is, using fires wholly disproportionate to the size of the boiler, or whose fire surface, as in the locomotive boiler, is very great (in either case, any sudden and unlooked-for stoppage of the efflux of steam gives a fair chance of explosion)—insufficient size of safety-valves, and ill-made or disordered boiler fittings; negligence on the part of those in care of the boiler. For these, and a thousand and one, possible other causes of explosion, as many recipes of prevention have been proposed; but to those who employ engines, and are not themselves engineers, one very simple one is the best. Get your engine from a maker of first-rate character; act implicitly by his designs, and employ sober and trustworthy men to take care of the well-arranged machinery so obtained: the chances of explosion here are very small indeed. For the special cause of explosion adduced by M. Jobard he proposes a special remedy, namely, that the feed-pump should always work (of course, he means in land engines,) out of an open cistern, exposed to the view of the stoker, so that he could see at once if the water ceased to be drawn away in the pump, by the supply to the cistern causing it to overflow. A better and neater arrangement for the same end would be, to use a close cistern, with a gauge float, so as to prevent dirt (the great cause of feed-pump derangement) from falling into it.

But neither this nor any other possible contrivance can replace a due degree of attention, and a mistake upon this head seems to vitiate, from the very beginning, the hundreds of projects—some ingenious, and most absurd—submitted continually with so much parade, "*à la*

commission des rondelles fusibles" of the Institute of France.

It may be remarked, in passing, that the "*grand resultat*" of this learned commission, the said "*rondelle fusible*" itself, seems now to be found by them to be, if not a perfectly worthless, at least a most trustless and deceitful contrivance, and even capable of producing explosion to those reposing in fancied security upon its use; for it is found that, by long exposure to high-pressure steam, the plates of fusible alloy gradually *exude* their more fusible constituent metal, and thus cease to be steam-tight; but before this has happened, the fusing temperature of the "rondelle" has, of course, been raised some degrees; and any one, who examines a table of temperatures and corresponding elasticities, will see how small an increment of temperature, in high-pressure steam, co-ordinates with an enormous increase of pressure.

Before taking leave of this subject, the writer would allude to two circumstances bearing less directly upon it. Mr. Parkes, in an article on what he calls the "Percussive action of Steam," published in the third volume of the Transactions of the Institution of Civil Engineers, part 5, at page 424, after stating his opinion, that most boiler explosions are characterised by suddenness, and few exhibit signs of the operation of a gradually increasing and continued force, adds, "We have examples of boilers, weighing many tons, ... being projected to a vast height or distance. . . . I am unable to comprehend why the simple elastic force of steam can be made to separate a boiler into two parts, projecting the one into the atmosphere and leaving the other quiescent . . . . . I have greater difficulty in understanding how the character of a projectile can be given to such a body, without its having received originally a sudden impulse, using that term as implying momentary action in contradistinction to continuous pressure." This certaintly seems a strange conclusion, a riding of the "percussive principle" to death. Is a sky-rocket in its ascent indebted to any sudden impulse? Or Barker's Mill, or, the "Turbine," to any sudden impulse? Or the upsetting of a tall upright jar full of water, by the reaction of a jet of water issuing out of its side? On the contrary, are these not all cases of simple unbalanced continuous pressure? But a circumstance which occurred sometime since upon a railway, with which the writer is acquainted, and the results of which were witnessed by him, set the matter in a very clear light. One of the oldest locomotives the Company possessed, with a spherical copper fire-box, had the interior of the latter worn so thin by constant use, that when reduced to about ⅛th of an inch in some places, it burst by bulging inwards while the engine and tender were standing on the rails, steam up, and at the ordinary pressure of about 60lbs per square inch, and blowing freely off at the safety valves.

The fire-box burst inwards, as stated, and the steam and water rushed out (like the gas or flame from the tail of a rocket) against the ground. The locomotive engine was instantly thrown (head over heels, so to say) upon the tender, tearing asunder the large connecting link. Fortunately, no men were on or near the engine, and so no one was hurt.

Now here was a gentle and gradual accumulation of pressure, which though not more than usual, was at last sufficient to rupture the copper plate; and the *unbalanced pressure*, reacting upon the boiler, "projected it into the atmosphere." And so this matter, (of which a much more curious case is recorded in a late Number of this Magazine, of an American steamer explosion,) is accounted for without any occasion for calling on the "percussive principle;" the precise physical meaning of which, be it remarked, it is exceedingly hard to see, and the evidences of which, in the various instances brought forwarded by Mr. Parkes, the writer, after a deliberate consideration, affirms (with every respect for that undoubtedly able and persevering gentleman,) are incapable, when rightly interpreted, and in accordance with the established laws of dynamics, of proving any thing novel, or beyond the well known and perfectly understood effects, of a constant force producing accelerated velocity in a given mass.

One word more. Amongst the many "recipes to produce an explosion" of a steam-boiler is one, which, although the writer has seen it noticed in an incomplete way, and he believes in this Magazine, yet he has not hitherto seen anywhere placed in the prominent position he believes it ought to occupy—he

alludes to *sudden or violent agitation* of the boiling water within a boiler, producing an instant surcharge of steam. For example:—

Take a common Florence flask, about half full of water. Boil the water over a lamp; when all ebullition has ceased, holding the flask steady, cork it. Take it now by the neck, in the hand, protected by a cloth, and give it one or two vigourous shakes. The flask will instantly burst, and with a pretty observable explosion.

Take another instance. He who lies sleepless in his berth, on board a steamboat, as in a gale—head to wind, the engines making perhaps twelve strokes per minute, the ship rolling from side to side, and steam constantly blowing off—will hear, at every roll, a constantly recurring sigh of escaping steam, louder considerably than that which is heard between the extremes of vibration. What is the cause of this? It may be said, the safety-valve, just held in suspension by the escaping steam, presses less upon the issuing column when at the extreme roll, than when vertically over it. This is true; but the arc of vibration is too small in most of the sea boats to allow of this accounting for the whole phenomenon. The truth is, the steam is now generated in fits. A gush of steam takes place as at each roll the huge wave of water inside the boilers is transferred across them, and lashes their inner sides—and hence the greater sound.

Take another. Whoever has observed a locomotive "backing up" to a train of carriages, to "hook on"—the steam just blowing off a little from the safety valves—will have noticed that, at the moment the buffers strike, a sudden gush of steam rushes out of both valves. The "percussive action" of the buffers here knocks the water about in the boiler, and, like the water shaken in the flask above, produces a surcharge of steam.

Take a fourth instance to show that the effect of this will be much more formidable when the boiler is full of air, as at first starting, after fresh filling. Brewers, to "sweeten" their casks, pour a little scalding-hot water into them, say, a gallon or so into a cask holding thirty or more. A man bungs up the aperture, and, seizing the cask, rolls and shakes it about in every direction. In a few seconds, if the bung be not *blown* out, he pulls it out, or rather starts it, when it flies out, accompanied by a very considerable rush of steam and air. Now the reason of this curious fact is obvious enough to any one acquainted with the elements of this branch of physics: so we need not stop to discuss it.

Here, then, we have a real cause frequently in operation, both on land and at sea, for sudden surcharges of steam, when every part of engine and boiler is in perfect order, and often sufficient to endanger or destroy the former.

It is a remarkable fact that the great majority of steamboat explosions which have happened, both in America and in Great Britain, have taken place at the moment of starting, after the boat has been "laying to." The explosion on the Clyde, a year or two since, and the latest American instance, were both so circumstanced. The few locomotive boilers, also, which have ever exploded while sound and in good condition, have "gone off" at the first moment of getting into motion; as, for instance, that which exploded in the station-house at Liverpool, some years since, in the act of backing up to a train. On the degree of danger really attributable to this cause, experiments are wanting, as well as on many other relating questions to this important subject, upon which the only experiments, of any real practical value, made as yet, appear to be those of the Franklin Institute, which, it is to be regretted, are so little known in these countries, and do not embrace the whole subject. Experiments, however, to be of any decisive authority, or practical value in the matter, must be made upon the large and practical scale. Experiments made on the laboratory table, and of the class of those which, from the combustion of a grain or two of potassium, dropped into water in a glass tube, are made the groundwork of deductions as to forces when tons of matter are put in motion, are only calculated speciously to mislead.

R. M.

Dublin, February 11, 1843.

APPLICATION OF THE SUN AND PLANET MOTION TO THE REDUCTION OF THE SPEED OF THE PISTONS AND VALVES OF LOCOMOTIVE ENGINES.

Sir,—When I consider the great velocity at which our locomotive engines are driven, I can scarcely suppress a feeling

of surprise, that no *practically good* method has yet been adopted for diminishing the speed of the pistons and valves, without diminishing the speed of the engine itself, as it is a well known fact, that they, (the pistons, valves, &c.) are subject to extremely rapid wear, from the great velocity at which they are worked.

As a remedy for the above evil, I do not see any objection (*when outside cylinders are used*,) to the use of that ingenious invention of our justly-celebrated countryman, Watt, the sun and planet motion, which it is obvious would diminish the speed of the piston one-half, the engine itself still going at the same rate, and thereby diminish the friction, and consequently the wear and tear, in a most efficient manner.

Suppose an engine with 5 feet driving wheels, is travelling at the rate of 30 miles an hour, which I believe is the average speed of a passenger train, then, $5 \times 3{\cdot}1416 = 15{\cdot}7080$, and $1760 \times 3{\cdot} = 5280$ which $\div 15{\cdot}7080 = 336{\cdot}154$ revolutions of driving wheels, and consequently the same number of double strokes of the pistons per mile, which is equal to upwards of 168 per minute, which by the use of the sun and planet motion would be diminished to 84. This, it must be allowed, would do away with an immense amount of friction, as well as (at least in a great measure,) with the necessity of balancing the cranks, as is now so universally done.

I remain yours, respectfully,

INVENTOR.

January 16, 1843.

ADHESIVE PROPERTIES OF SHELL-LAC.

Sir,—In your Number for Saturday last, the 11th instant, there are some judicious remarks by Mr. Joiner, on the nature of shell-lac as a cement. I have used it, more than twenty years ago, in the East Indies, for the purpose of joining pieces of wood, and I did not find that the greatest heat of a tropical sun had any effect on it, so as to impair its tenacity. The manner I proceeded was this: the lac was dissolved in spirits of wine, so as to make a thick varnish, and then laid on the pieces of wood with a brush, like paint; a piece of crape or gauze was then interposed, and the parts pressed together for two or three days, till the cement had thoroughly set. This method I adopted in consequence of observing that the natives on the Malabar coast, and the Mogul and Tartar bow-makers, use gauze, with the glue or cement, in joining the wood with which their bows are made.

Your obedient servant,

JOHN NORTON,

(Late Capt. 34th Regiment.)

P.S.—I have tested this means of joining wood, by throwing a block of two pieces, four inches square each, and cemented without the addition of the gauze, from a height of fifty feet, on the stone pavement, and in three instances the pieces separated by the concussion, but in three other instances, where gauze was interposed, the pieces did not separate. This is an experiment easy of trial.

THE CALOTYPE PATENT.

Sir,—I am encouraged by your very just remarks on the complaint made by the Edinburgh Review respecting the Daguerreotype patent, to request insertion of a few words on what is said in the same journal respecting the calotype process of Mr. Talbot.

"The Royal Society," says the reviewer, "the philosophical organ of the nation, has refused to publish its processes in their Transactions. No Arago—no Gay Lussac—drew to it the notice of the premier or his government. No representative of the people or the peers unanimously recommended a national reward. No enterprising artists started for our colonies to pourtray their scenery, or repaired to our insular rocks and glens to delineate their beauty and their grandeur. The inventor was left to find the reward of his labours in the doubtful privileges of a patent."

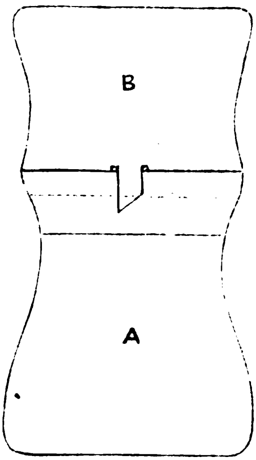
It may suffice for an answer to this eloquent tirade, to observe that the inventor was not, as is alleged, "*left* to find the reward of his labours in the doubtful privileges of a patent;" but preferred for himself, from the very first, this mode of rewarding himself to all others. Mr. Talbot communicated the details of his process to the Royal Society; but not till *after* he had first secured it by patent. The proposition of any "national reward," under such circumstances, would have been altogether out of place. The time for such a thing—if ever it should arrive—will be when the patent has expired. If Mr. Talbot can then show that he has not derived advantages from the

fourteen years' monopoly of his process, which he took care to secure to himself, commensurate with those which it has conferred on the public, it will become a fair subject for consideration, whether he ought not, like Cartwright and Fourdrinier, to have the deficiency made up by a national grant; but until then there is nothing to be said. Mr. Talbot has chosen his own course, and ought *contentedly* to abide by it.

I am, Sir, your obedient servant,

F. R. S.

USEFUL APPENDAGE TO FILTERING VESSELS.



Sir,—We often see troublesome practices, involving frequent acts of attention, persisted in and unimproved upon, from year to year, when we have simple expedients at hand, to save trouble and obviate the chances of carelessness, neglect or forgetfulness. Of this character is the manner of supplying a filtering apparatus with water to be purified; which (I am here speaking of the patent filtering vessels so much in use,) is done by filling from time to time the shallow basin at top, capable of containing but a small quantity, which soon passes through the filter, and requires to be frequently renewed. It would naturally be thought, that they would have been so constructed as to receive at once as large a supply of unpurified water as the receiver below is capable of containing of filtered water, and this may be done, not only without increasing the head of water lying on the sponge (if that be the object desired,) but so as to preserve an uniform pressure on the filter, by having the same quantity of water always above it. It is merely by inverting another vessel of the same size as the receiver below, with its mouth dipping into the head water lying on the sponge, on the principle of a fountain reservoir, as represented in the accompanying figure. A is the filtering apparatus as at present in use; B, another vessel of the same material, and capable of containing as much water as the machine is intended to filter, inverted over it with its mouth dipping into the water in the shallow receptacle, as indicated by the dotted line. As the water passes through the filter, and the surface becomes lowered, air enters the mouth and displaces a certain portion of water from B to restore it to the same height; and in this manner a uniform quantity of water is preserved above the filter, until B is exhausted. A slanting form is given to the mouth as more favourable for the gradual admission of air, than a flat or horizontal form.

The upper vessel B is not only useful as a reservoir for the water to be filtered, but, to say nothing of its services as a cover to prevent dust and additional impurities getting into the water, it answers also the purpose of an auxiliary filter *by deposition:* for between the time of its being filled and exhausted, a certain portion of the impurities is deposited inside the vessel, and the general condition of the water, as supplied to the filter, is in a purer state than it would otherwise have been. For the purpose of more effectually retaining the sediment, without preventing all the water from passing out, there should be a raised rim inside, surrounding the neck, or opening, with two or three small channels in it, just sufficient to permit the water to ooze out without facilitating the passage of the sediment.

The same appendage may of course be as usefully applied to any other kind of filtering apparatus, as the one more specifically under notice.

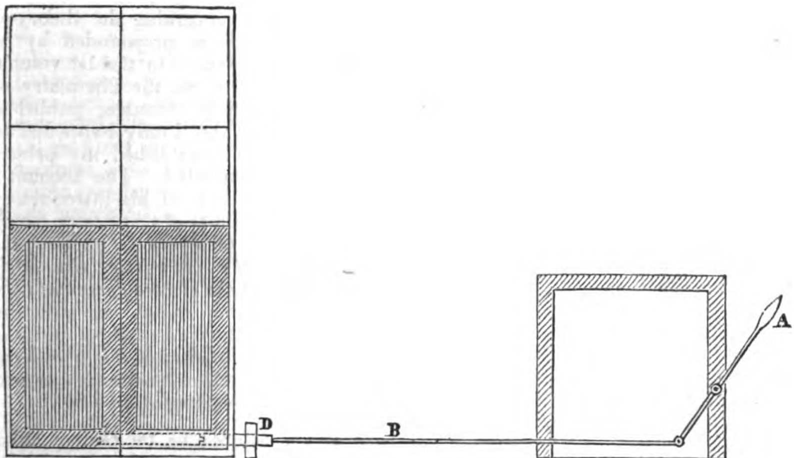
I am, Sir,

Your obedient servant,

N. N. L.

February, 1843.

IMPROVED APPARATUS FOR THE PREVENTION OF SHOP ROBBERIES.



Sir,—I send you a sketch of a plan for the above purpose, which will be found to possess considerable advantages over the plan proposed by Mr. Bayston, in a late Number of your Magazine, which, although it shows considerable ingenuity in its construction, is open to some serious objections.

A is the lever, which is connected to the fastener by the rod B, which is connected to the bolt C, which runs through a mortise in the door, nearest the lever, and enters the opposite one by another, but shorter mortise, as shown by the dotted lines, and has a joint at E, to allow the door to open, when it is released by the bolt being drawn back. This mode, it will be perceived, is much simpler in its construction, and consequently less costly, than the plan before referred to.

I remain, yours respectfully,

INVENTOR.

PHOTIC FLUIDS—THE HISTORY OF CHEMISTRY.

Sir,—I have great pleasure to say, that I consider your correspondent "Cogito's" second letter in reply to my answer to his first comment on my hints concerning matter, perfectly satisfactory, and such as I am bound fully to appreciate and to pay particular attention to. I confess to you, that his first letter had made me entertain some doubts as to the friendliness of his remarks, while the second proves to me the contrary. I can assure him, that the objections which he now makes are exactly what I was prepared for, and so much prepared for, that the dread of having to combat them had prevented me from stepping publicly forward with my theory until you drew my attention to Dr. Möser's experiments. The perfect coincidence of the facts which he sets forth, with my own conviction, brought me into the field, or rather pushed me into it. "Cogito" *now* states clearly, where he has understood me, and where not; and that by the "Antagonist Essences" he meant the "Phlogistic" theory, which he conceives to imply a double machinery; at the same time acknowledging that the "centripetal and centrifugal tendencies" set forth by me, "*were not then thought of*," nor were thereby elucidated. He further admits one great point, namely, the "*existence of photic fluids*," so that the question about them at issue between us, is no longer, *that* they are, but *what* they are. Thus there now exists an approximation between us, in some respects, at least, and I am not only enabled,

but also bound to argue with him concerning the points on which we yet differ.

In his summary of my propositions he overlooks one main feature, alluded to in my first letter, namely, that the contents of what we call a *vacuum*, or exhausted space, (provided it really be exhausted of elemental matter,) may be identical with the ether impregnated with photic fluids. It follows from this stipulation of mine, that we are probably able to examine the nature and properties of imponderable fluids *in nudibus*. I therefore request him to make this addition to the first passage of his summary.

"Cogito" then says, that he does not comment on the first two propositions, such as he states them, because he does not yet sufficiently understand them. It is impossible that he should, for as yet I have neither explained, *how* I got by those principles, nor shown by what specific laws they are connected with each element; nor can I do so, till I give my system in detail. The further discussion of these questions must therefore remain in abeyance for the present.

In regard to my assumption of a sixtuple photic fluid, he thinks that to be *old*, in the first place, and erroneous in the second. In reply, I can assure him that I was not aware of its being *old*; for I have nowhere met with an enumeration of six photic fluids in any shape, much less in that of their identity with the four electro-magnetic polarities; combined with distinct black and white light and an ether. Therefore I, at any rate, have not derived them from any *old* scientific theory that may exist unknown to me. As to their being erroneous, we are in the same predicament as in regard to the other questions.

I am, as above said, glad to learn that by the "Antagonist Essences," he meant the phlogistic theory; for, on the one hand, this is intelligible to me; and on the other, I comprehend also, that he could not understand any part of my propositions, as long as he did not see the difference there is between them and the phlogiston of old. It is the object of the present letter to point out that difference, together with my own position, as a necessary preliminary to all further progress.

May I then be allowed to state, that in my studies I have chiefly applied myself to some of the *newest* English and foreign works on chemistry and astronomy, and that the only account I have seen and wished to see, concerning the theory of phlogiston, such as propounded by its *founder*, is contained in the 1st volume of a very able work, the Chemistry of Dr. Kutzing, of Nordhausen, published in 1838, but which I only happened to read *after* I had established my principles in my own mind. The account I speak of forms part of his introductory sketch of the History of Chemistry, which he divides into four periods, namely, *the alchymistic*, *the phlogistic*, *the anti-phlogistic*, and *the electro-chemical*; the last being that in which we still are. After having duly despatched the absurdities and mysticism of the long-lived *alchymistic* period, he says with regard to the second, or *phlogistic*,—

"It was founded by Dr. George Ernst Stahl, who was born at Anspach, in 1660, and died in 1776, at Berlin, as physician in ordinary to the King of Prussia, after having previously, for 22 years, been ordinary Professor of Medicine at Halle, and delivered chemical and medical lectures with great applause. His system was founded on the hypothetical assumption of a combustible principle or *element*, which he called 'phlogiston.'" (N.B. He meant a *single*, or *simple* ponderable element, convertible into the flame of fire, a thing of which I know nothing.) "According to him every thing that burnt, or was combustible, was indebted for this property to the presence of the phlogiston; all metals, sulphur, coal, pitch, oil, wood, &c., consisted of this combustible, (single element,) which in their respective substances was combined with other matters." (N.B. This is a good basis for the theory of undulation, according to which matter has *its own power* to burn and radiate; consequently to get rid of inertia, when in contact with an opponent neighbour!) "Such bodies as were most easily inflammable, according to his theory, contained a greater quantity of the (ponderable) phlogiston than others, which were less easily combustible. Now, when the metals, at the melting point, lost their metallic appearance—for instance, lead, tin, iron, copper—and were converted into an earthy or a limy mass, which he called 'metallic calx,' he accounted for the phenomenon by assuming that, in the process of melting, the phlogiston escaped from its prior combination with the metals." (I admit no such thing with reference to any element.) "Thus the metals consisted of earth, (calx), and phlogiston. But such

earths might again be converted into metals, by bringing them into contact with matter containing much phlogiston, (for instance, coal, oil, tallow, rosin,) exposing them at the same time to a high heat, whereby the latter transferred their phlogiston to the earth, and re-established the metal. Although this theory was subsequently found to be erroneous, yet it was the *first impulse*, and consequently Stahl's merit, to give a scientific foundation to elemental chemistry, and to separate it gradually from the art of *gold-making*, by identifying the latter with chimerical alchemy; for although the metals could be produced from *some* earthy matters, the notion was at last given up, that *coarse* metals could be converted into *precious* ones. In this same period of the famous Stahl, other men also distinguished themselves, whose names science even now records with the greatest esteem. Priestley and Scheele belong to the same period: both of them, *independently* of each other, at the same time discovered the oxygen gas, and thereby introduced one of the most important periods of chemistry; for, without this important discovery, that science would still be in its infancy, while since that time it has developed itself with gigantic strides, and now takes up, in natural sciences, the first place next to astronomy. The succeeding periods follow each other so rapidly, that there are still living chemists, who, beginning with the phlogistic period, have fought their way through the whole cyclus.

"In a time when such men as Scheele, Priestley, Bergmann, Crell, Boerhaave, and other famous chemists lived, it could not take a long time to discover the fallacy of the phlogistic theory: for if the metals, when brought to a melting state, could lose their (ponderable) phlogiston, they could not but also *lose in weight* by combustion; but the very contrary was the case: the remaining earth, into which the combustionized metal was converted, weighed *more* than the original quantity did. Although the zealous defenders of the phlogiston now endeavoured to save the principle, by ascribing to it a negative weight, this device only availed them a short time in their dilemma; for it did not last long, till the accurate experiments of Lavoisier dethroned phlogiston, in order to enthrone oxygen in its stead."

Here I beg leave to observe, that this account makes no mention of the *exact* phlogistic theory having originally set forth a principle of *imponderable antagonist*, or *phlogistic* and *antiphlogistic essences;* and that this, in fact, resembles our present *electro-magnetic theory*, which shows the "positives" to steer and attract one way, and the "negatives" another, thus advocating double electricity and double magnetism, each combined in the centre. Thus science has a double machinery, with four poles. Dr. Kutzing continues:—

"The third period is that of *antiphlogistic* chemistry. It begins with the year 1783, and was founded by Lavoisier, in Paris, (born 1743.) He proved, by accurate experiments, that metals, being melted by heat, not only *lose nothing* of their weight, but even, on the contrary, *gain by attracting something from the atmosphere*, and that they lose their metallic aspect and consistency by *combining with this something.* This *material* something, which he again succeeded to separate from the metals, he called 'oxygène;' while Hermstadt gave it a German name, signifying 'acid matter.' The *fourth*, or *electro-chemical* period begins with the year 1807, when Sir Humphrey Davy discovered that the alkalis and earths were decomposable into peculiar metals and oxygen; and he did so by means of the galvanic battery. This last is our present stage."

The original phlogistic theory, accordingly, seems to have been rather different from what "Cogito" presumes it was; and it is, at any rate, far from any similarity with my principles; for the phlogiston was conceived to exist in the shape of a *ponderable* element combined with others. When it was found out that it could not be maintained in that shape, an attempt was made to translate it into an imponderable lord spiritual, and as such it died. Soon after, the phlogistic idea was in fact resuscitated in the shape of another *double ponderable machinery*, by adapting it to the functions held by *oxygen* and *hydrogen*, as is proved by James Watt's communications to Dr. Priestley: (see Lardner's "Steam Engine," page 307,) carbon, phosporus, sulphur, &c. became "aides-de-camp." But all this, as far, as it went, had nothing to do with photic fluids or galvanism. And still less am I inclined to adopt any *older* notions or principles formed in times, in which nobody yet knew anything about the existence and elementarity of gases, or of *air* as being *not* an imponderable, but a ponderable compound of volatilized elements, which may be found combined with the hardest metals in a highly dense condition, and which I consider to be merely gaseous when freely floating in, atomically

expanded by, and centrally much fraught with, *the ether* that surrounds, presses upon, and pervades the terrestrial atmosphere and body. And pray, how long is it yet, *since we knew*, that there is such a thing as space, totally deprived of elemental matter, or an exclusion from it of the *terrestrial* ponderables? So that there is no more occasion to *assume at a low temperature*, an almost infinite and chimerical rarifiability of air, tantamount to imponderability.

As to any general theories of the constitution of the universe, formed prior to the recent discoveries in astronomy and chemistry, I know of none embracing the whole system, and accounting satisfactorily for the real nature of, and the connexion between, ponderable and imponderable matters, and even now the prevailing opinions on many essential questions are still so vague, inconsistent, and contradictory, that an approximation between them seems to be impossible.

I do not, however, despair of its being sooner or later accomplished by joint efforts, and to this great end every reflecting man is bound to contribute his mite as he may, for in this respect even a single hint or new idea, if supported by a coincidence of known facts, may go a long way towards arriving at general fundamental laws, that may hold good throughout.

I remain most truly, Sir,
Your most obedient servant,
Z.

P.S. I am by no means unacquainted with the scientific tenets of antiquity, so frequently recapitulated by the moderns. The *ancients* had formed *many* hypotheses, and got up many names for mysterious things and notions about things; but they were very deficient in radical principles and the knowledge of *experimental facts*, for establishing *truths* beyond a doubt. Thus, for instance, every thing said and written about the law of gravitation or attraction, even by *Newton himself*, *prior* to 1682, was *old* and amounted to *mere rational conjecture*, until in that year, Newton succeeded in *proving the truth* by *new* facts: by that means, and from that moment, it became a perfect *novelty*, and as *such*, *a great discovery;* which it still took him *four years*, to work it out fully, so as to be able to publish his "Principia" in 1686.

Z

London, February 4, 1843.

SHORT AND SIMPLE METHODS OF CALCULATING COMMISSION, BROKERAGE, ETC. BY MR. J. STERLAND.

The following is a concise and simple method of finding (within one penny) the Commission—Brokerage—Premium of Insurance—Interest per Annum—Discount off Invoices—or the Per Centage allowed for ready money payments, &c., on any number of pounds, and at any rate per cent., from ⅛th inclusive, and progressing by ⅛th per cent., *ad infinitum*.

Rule.—Multiply the given number of pounds by twice the rate per cent. Take the unit for the pence, and the remaining figures are the shillings.

Thus, the commission, &c. on 83*l.* at 2 per cent., is found by multiplying 83 by 4, which makes 332, that is, 33*s.* 2*d.*, or 1*l.* 13*s.* 2*d.*

But when the unit is more than 4, and when the shillings produced by the multiplication are more than 5, then one penny must be added to the result for each unit and fraction.

Thus, for the commission, &c. on 58*l.* at 6¼ per cent., multiply 58 by 12½, which makes 725. Add 1 for the unit being more than 4, and it is then 726, that is, 72*s.* 6*d.*, or 3*l.* 12*s.* 6*d.*

For the commission, &c. on 125*l.* at 3⅜ per cent., multiply 125 by 6¾, which makes 843*l.* 15*s.* Add 1 for the shillings being more than 5, and it is then 844, that is, 84*s.* 4*d.*, or 4*l.* 4*s.* 4*d.*

For the commission, &c. on 134 at 5⅝ per cent., multiply 134 by 11¼, which makes 1507*l.* 10*s.* Add 1 for the unit being more than 4, and 1 for the shillings being more than 5, it is then 1509, that is, 150*s.* 9*d.*, or 7*l.* 10*s.* 9*d.*

Half, or 10*s.* per cent., is found at sight, *instanter.* By adding one penny when the unit is more than 4, the given sum shows its own commission, &c., thus, on 164*l.* it is 16*s.* 4*d.*, and on 165*l.* it is 16*s.* 6*d.*

In finding the commission, &c. by tables, it frequently requires (when the rate is above 5 per cent., say 58*l.* at 6¼ per cent.) reference to two pages, then to two columns, then to four (sometimes eight) lines, then to pick out the parts from each of them, and then to add the whole together, with liability to err in every operation. By my method you have simply to multiply 58 by 12½, which makes 725, adding 1*d.* for the unit, which gives 726, that is, 3*l.* 12*s.* 6*d.*

I do not pretend to be infallible, or more accurate than tables usually are; neither do I offer this method as superior to all others. Such as it is, I present it gratuitously to the commercial public. Figures have, for some years past, been my favourite amusement;

I therefore do not expect, and cannot receive, remuneration in any shape whatever, either directly or indirectly, present or prospective.

J. STERLAND.

Margate, Feb. 4, 1843.

Remarks.

The shillings produced by the multiplication (if any) are 15, 10, or 5. When there are no shillings, my commission is exact.

When 15*s*., my commission, &c. is one tenth of a penny (which is not a farthing) too much.

When 10*s*., it is four-tenths (which is not a halfpenny) too much.

When 5*s*., it is three-tenths (which is not a halfpenny) too little.

Query.—What is that sum and rate per cent., on which my commission, &c. will be more than one penny too much or too little?

J. S.

THE GAS-METER QUESTION.

Sir,—Having attended the various lectures delivered at the Adelaide Gallery on gas-meters, I was led to expect, from the lecturer's language at commencing, that he had discovered some very flagrant error that would justify the aspersions he was pleased to throw out against one of the most beautiful and mathematically correct measures (the wet gas-meter) in existence. His discoveries amount literally to nothing; the whole of his alleged "fallacies" resolving themselves into the old affair of the variation of the water-line. With as much reason might we abandon the use of watches because of their going sometimes fast and sometimes slow, though by occasional regulation they can be made to maintain a tolerably uniform rate. Just so is the case with the meter; for if the water line is kept properly adjusted, it measures accurately. Whose fault is it, if it be not so kept? Not, certainly, that of the Company, but of the consumer, in whose power it is, and whose interest it is, to see that it is not registering against himself.

From experience attained by having had nearly a thousand meters fixed under my superintendence, and from having made a point of attending to their operation afterwards, I find that an excess of water in a meter is a very rare occurrence, though a deficiency is common enough. This is easily accounted for by the fact of the gas-meter being, in nearly all cases, fixed *above the main*, which consequently becomes a receiver of a portion of the evaporation from the meter, whilst the other part is collected in syphons inserted in the interior fittings for the purpose, which thus prevents the return of the water to the meter.

Mr. Jones stated in one of his lectures, that the water collected in the meter from condensation of the gas during combustion, and this condensation, according to his theory, passes through the flame and apertures of the burner into the fittings, and from thence to the meter! If this be not a specimen of total ignorance of the subject, I will then admit that the gas-meter is an inaccurate measurer, but not till then. As far as I can learn, the only case where water accumulates in the meter from natural causes is where the meter has been, through the ignorance of the fitter, fixed *below* the main pipe, when the meter then acts as a syphon for the main. I have known this in several cases, and I believe that it is only in meters fixed under such circumstances that there can possibly be any accumulation of water.

By paying due attention to the place in which the wet meter is fixed, the defect of freezing ceases to exist.

If Mr. Jones really wishes to promote truth, why not perform his experiments on meters made by the principal makers? I am sure he would find them correct to a nicety, and he could obtain some of them to test that have been in use fourteen years and upwards. To try to prove a machine is useless, by some of the worst of the kind, is "too bad."

I am, Sir, yours &c.,

A WET GAS-METER.

GAS-METERS—MR. WRIGHT'S LECTURES.

Mr. Wright's two lectures on the construction of gas-meters, or measures for measuring gaseous fluids, delivered on the evenings of Tuesdays the 7th and the 14th inst., at the Literary and Scientific and Mechanics' Institution, Great Smith-street, Westminster.

In accordance with our notice to correspondents last week, we now proceed to give a summary of these lectures. Mr. Wright, the lecturer, is a young man, of whom, as becomes us, we shall say but little. This much, however, the unanimous expression of approval which his labours received warrants us in saying—he is evidently self-educated, and, like many of that independent class, *well* educated—he possesses a thorough practical knowledge of his subject—managed his experiments rather indifferently, but applied his results felicitously—and delivered his opinions in familiar, correct, and perspicuous language.

The lecturer first touched on the importance of his subject. It embraced some of

the most beautiful laws of nature — was deeply interesting for the science it involved —and worthy of examination, because, in the present advanced state of gas illumination, it entered largely into the economy of domestic expenditure. The benefits conferred by the substitution of coal-gas for previous modes of lighting could never be estimated, nor be thoroughly disseminated, until the *measure* by which it was supplied was understood, and attested to be alike impartial and faithful to the consumer and the manufacturer. Nor until the ruinous mode of contract distribution was entirely abandoned, and the gas-meter universally adopted, would Gas Companies be enabled to supply consumers at a reduced price, and so increase their own dividends, which were now on the average greatly below what the speculation demanded. The late attempt to unhinge the public mind, from whatever motives it originated, was calculated to obstruct the accomplishment of this desirable object. By the insidious exaggeration of defects, to which, in common with all human contrivances, the meter was liable, and by the conversion of rare and uncommon, into general and universal occurrences, an infamous charge of fraud and robbery had been brought against gentlemen and establishments of unimpeachable honour and integrity. The baseness of the motives was only equalled by the puerility and extravagance of the efforts. A fair explanation of the machines would be an unanswerable refutation of these imputations and calumnies, and an exposure of the ignorance and temerity of the originators and abettors of them. When he reflected upon the ingenuity of the gas-meter, he was surprised that it had not excited the interest and engaged the curiosity of the public long ago; especially since he found that upon many mechanical matters which less concerned them, more information was generally diffused. The steam-engine, for instance, was understood by most men, and every tyro in mechanics fashioned to himself some model of this stupendous power; yet the gas-meter, which entered into our very homes, and, like a watchful spy, noted down every atom of that most subtle fluid which passed through its chambers, was very imperfectly understood. He hoped it would not prove uninteresting to examine by what "mighty magic" these wonders were accomplished, and the ingenuity of man had thus been enabled to grasp even the winds of heaven and determine their quantity. This science might be said to have sprung into existence within the last thirty years, for previous to that time no self-acting machinery for measuring fluids was in use, and the process by manual operation was exclusively confined to the closet of the philosopher.

The methods of measuring gaseous fluids were various. The oldest and most convenient in practice, as well as the most accurate, was by displacing liquids, such as water or mercury, from chambers or cylinders of known dimensions, by means of the gas to be measured. The graduated tube, and the mercurial trough of the laboratory, and the gas-holder, and the gas-meter, were but different modifications of the same principle.

The lecturer next described the nature of coal gas, and the several conditions which alter its bulk, and consequently interfere with its (theoretically speaking) correct measurement. He then explained the science of pressure; investigated the laws and phenomena of compression; vindicated the principle of the metre, and demonstrated the fallacy of the assertion which had been made, that gas measures differently at different pressures—following out on this point the line of argument taken by Mr. Tweed at the Adelaide Gallery. See *Mech. Mag.* No. 1017.

It was finally demonstrated, by showing the skeleton and parts of the wheel or drum of the meter, that the chambers were only increased or decreased according to the friction of the working parts of the meter, and this to a very slight *and exceedingly minute* extent; and that every increase of pressure, however great, even a double atmosphere, would increase the density of the gas, but not the capacity of the chambers of the drum.

The lecturer then explained the construction and action of every part of the water meter, and the various improvements which had been made upon it, since its first invention by Mr. Samuel Clegg, familiarly illustrating and aiding the conception of the subject by a reference to drawings and diagrams hung up and conveniently displayed to the view of his audience.

The lecturer next adverted to Mr. Botten's water meter, and also to one invented by Mr. Edge, both of which have for their object the prevention of any excess of water in the meter. An index, the lecturer's own invention, patented by Mr. Edge, was likewise exhibited, so constructed that a consumer simply understanding the first rule of common arithmetic, cannot fail to understand the registration.

The lecturer then briefly sketched the history of the dry meter. He stated that Mr. Samuel Clegg, had previous to the invention of the wet meter, turned his attention to the use of bladders or diaphragms, and read a passage from the work of Mr. Clegg, Jun., describing the causes of his failure. Mr. Malam also patented a machine of this description, which resembled a pair of bellows. The next was an importation from

America; the valves of which he exhibited and explained their action. The patent for this meter was afterwards sold to a company that had been called the "North Road Dry Meter Company." This Company had employed engineers and chemists, and built large premises for the manufactory of this meter, and had spent in a few years £24,000, but had ultimately abandoned the scheme. He had conversed with gentlemen connected with the concern who had assured him, that no substance with which they were acquainted, was fit for a diaphragm, which could withstand the action of the gas. The construction of Mr. Defries's dry meter, as first patented, was then examined. Another dry meter, the invention of Messrs. Peckston and Le Capelain, was then exhibited, and spoken of with great approbation. (For a full description of this, see the first article in our present Number.) The lecturer then proceeded as follows:—"I am aware that in giving my opinion of the comparative merits of the wet and the dry meter, my motives and my judgment are alike liable to be questioned. I am also aware that time, that best of judges, must soon determine between them, and therefore my opinions, if erroneously formed, must shortly appear to my discredit. It is, therefore, after mature consideration of this important subject that I draw this comparison. The measuring chambers of the wet meter are formed on five sides, of a metallic substance unalterable in size and shape, and (as has been proved) capable of withstanding the chemical action of the gas fluid it measures. The sixth and least important of their sides, being less in superficial extent, is formed of water, from the variations of the level of which, as corrected by the latest improvements, no more difference can be made in capacity than 1½ per cent. on either side. The measuring chambers of the dry meter are composed of an animal substance, generally split sheep skins; the innumerable pores through which the gas could easily make its way are stopped up with black-lead and grease. If these meters are placed in a hot and dry situation, this matter runs out, and deposits itself in pools at the bottom (this was shown to be the case); and the diaphragms become parched and shrunk up so much, that they have been known to register 17½ per cent. against the consumer, although they had registered correctly when they passed the Company's standard. If they are placed in damp situations, the impurities of the gas will act with greater violence on the fleshmarks and faulty parts of the under skin; and the diaphragms, like those of the former dry meters, become rotten and leaky. The valves of the wet meter are all hydraulic; and whether they be jagged on the edge like a saw, or covered with encrusted matter, they will still perform their duty with efficacy. The valves of the dry meter are formed by flat surfaces of metal, and liable to disarrangement; for if a particle of dust, scarcely perceptible to the human eye, be lodged underneath, they will become unsound; and the fact of warping the surfaces of these valves has been known to alter the registration of a dry meter 4 per cent. The advocates for the dry meter have laboured to prove that water accumulates in meters generally. If this be correct, nothing can be more destructive to *their* system, as this water is never *pure*, but always impregnated with tar and ammonia, the action of which upon their delicate machinery must shortly prove fatal to them. It may be objected to this, that the syphons which are floated at either side of them will remedy this defect. These syphons, however, will only receive the condensation of the pipes; but the aqueous vapour which is condensed in the meter must remain there, and even if drawn off will leave a residue of glutinous matter; and it is important here to state that depositions of naphthaline frequently take place in narrow openings, such as the gratings of the valves; and that two 50-light dry meters have been permanently removed from the Chartered Gas-Works on account of this defect.

"The water meter will not register correctly unless kept in a horizontal position; but this can be easily obviated by nailing it in its place. The dry gas-meter, by being turned upside down, and placed on its feet again, has been known to register 4 per cent. differently to what it did before; and from the experiments I have tried with them, I should not be able to state what a meter registered afterwards, if once it had been carried across the street and back again. The wet meter is subject to variable registration from the difference of the level line of water, and this has been termed *measuring water* instead of gas. The dry meter is subject to greater variation from the shrinking of the diaphragms, and this may very appropriately be called *measuring leather instead of gas*. The amount of the former may be ascertained and corrected by examining the water level; the latter is a *secret enemy*, and gives no outward indication of its fallacious measurement. With regard to the freezing of wet meters, there will generally be sufficient moisture in the valves of dry meters in cold situations to form a small portion of ice, and we know that gas-cocks and gas-valves freeze in cold situations, and it cannot be doubted that the valves of the dry gas-meter will also freeze. What must then become of those delicate levers which move those valves?

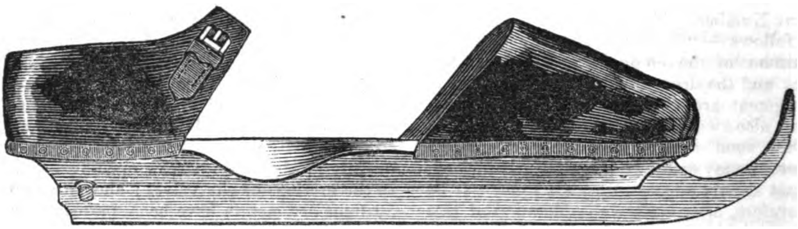
They must be either broken or bent, and whichever takes place, the disarrangement of the machine is certain.

"The wet gas-meter has been in use many years, and its faults are all known: the faults of the dry gas-meter are only now beginning to show themselves. The wet gas-meter has made the fortune of the original holder of the patent. The dry gas-meter has been thirty years in inventing, and has ruined almost every one who has had any thing to do with it. It has been the *ignis fatuus* of men of genius, dancing before their eyes when still far from their reach, and just as they had fancied themselves to have caught the desired object, it vanished, and left them in a quagmire of difficulty.

"Many ingenious schemes have been formed on this subject, worthy of a better fate, but the principle is bad, and, like splendid palaces built upon sand, they have tumbled to ruin. Like the north-west passage to India, it is a most desirable thing, but even if found, it is so beset with difficulties as to be quite impracticable."

[We must guard our readers against being led wrong by Mr. Wright's sweeping condemnation of *all* dry meters. It may suffice here to observe, that it rests chiefly on the defectiveness of the leather diaphragms, an objection which does not apply at all to Mr. Clegg's dry meter, which *has no diaphragms of any sort*.—Ed. M.M.

KITCHEN'S IMPROVED SKATE.



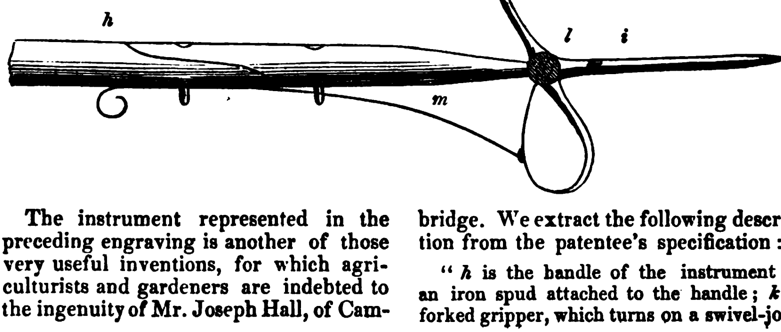
(Registered pursuant to Act of Parliament.)

Sir,—As we are now likely to have some ice, and therefore use for skates, I forward a sketch of one which appears to possess great advantages over any I have yet seen; it requires no hole to be bored in the heel of the boot, and is firmly secured to the foot by one single buckling.

The wooden part is made the size of the sole of the boot, with a piece cut away to receive the heel; two pieces of stout leather are then nailed on to the front and back parts, with a single strap to buckle across the instep, as in the ordinary clog. By giving the above an early place in your interesting and valuable columns, you will oblige

A Skater.

HALL'S PATENT LAND CRAB, OR WEED EXTRACTOR.



The instrument represented in the preceding engraving is another of those very useful inventions, for which agriculturists and gardeners are indebted to the ingenuity of Mr. Joseph Hall, of Cambridge. We extract the following description from the patentee's specification:—

"*h* is the handle of the instrument; *i* an iron spud attached to the handle; *k*, a forked gripper, which turns on a swivel-joint

at the point *l* of the handle; *m* is a thin rod, with a hook at top, which slides through eye-pieces fixed in the back of the handle, and is united to the bottom of the forked gripper *k*, so that by moving the rod up or down, the forked end of the gripper can be raised or lowered at pleasure. When the weed has been uprooted by the spud *i*, the rod *m* is pulled up, which brings the forked end of the gripper down upon and secures the weed, the two forks of the gripper falling in holes or recesses, provided for them in the shoulder-piece of the spud. To release the weed, the rod *m* is then pushed down, which draws back the forked end of the gripper, after which the instrument is again ready for use."

EWBANK'S BOOK OF HYDRAULICS.*

Mr. Ewbank is an American cultivator of mechanical science, of considerable repute in his own country, and well known, also, through its scientific journals, to European readers, as a gentleman of great practical knowledge, and a most ingenious, sagacious, and successful experimenter. We have, at different times, enriched our pages by transferring to them productions of Mr. Ewbank's pen. The last was a very instructive paper, on increasing the draft of chimneys, inserted in our 1001st Number. Mr. Ewbank is the author, also, of many useful inventions; among which the most worthy to be noted is, probably, his process for tinning lead pipes, (by passing them, after being drawn and finished, through a bath of liquid tin,) which was patented a few years ago in this country, and is coming into extensive use amongst us.

Mr. Ewbank's most remarkable and valuable contribution to mechanical philosophy is, however, beyond all comparison, the work before us. It entitles him to take rank at once with the very best writers in this department of literature, whether ancient or modern. If not so fertile in original invention as Besson, or Bellidor, or Desaguliers Ewbank shows a far more comprehensive knowledge of the inventions of others, and a much juster appreciation of their respective merits: quite as entertaining as Beckman, he exceeds him immeasurably in practical usefulness; and while aiming, like Ferguson, at a popular style, he brings to his aid a liveliness of fancy, depth of feeling, and eloquence of expression, to which Ferguson was a stranger. In Mr. Ewbank's book we have the ripe fruit of a long life's labour: not that he has been all his life employed upon it, but that it has for some forty years, at least, constantly occupied a large space in his thoughts—serving at once as a guiding-star to him in his readings and reflections, and as a treasury in which he has heaped, from time to time, his gleanings and his speculations. "I have sought," he says, "for information wherever I could find it; and with this view I have perused more volumes than it would be prudent to name." —(Pref., p. iv.) We can well believe him; for we have seldom before met with a volume so absolutely crammed with useful information, not only on all the subjects of which it professes to treat, but on every other which has the least relation to them. It puts us, in this respect, more in mind of one of the excellent Dictionaries of Mr. Loudon, than of any other modern author we can name; to whose writings it bears also a strong resemblance, in the frequent touches of moral and political sentiment, by which its drier technical details are relieved.

To give, within any moderate space, an analysis of the book is impossible. It may convey some idea of its contents to say, that it contains as many chapters as there are weeks in the year; as many engravings (nearly) as there are days in the year; and a separate subject for every waking hour of every day of the year: but perhaps the truest way to describe the vast multiplicity of its contents would be, to say that you will find in it every thing you could expect to find in such a work, (with few exceptions,) and *a great deal more.* The utmost we can do with such a work is, to give some specimens, and leave the reader to judge, from them, of the rest.

* A Descriptive and Historical Account of Hydraulic and other Machines for Raising Water, Ancient and Modern; including the Progressive Development of the Steam-engine. By Thomas Ewbank. Pp. 582, royal 8vo, with numerous engravings. London: Tilt and Bogue.

We meet at the very threshold with a passage which irresistibly compels quotation. We forgive the *Americanism* of the author's *instances*, for the sake of the general truth of his remarks, and the great moral lesson which they convey.

Importance of the Mechanical Arts.

"Remarks have occasionally been introduced on the importance of the mechanical arts, and the real dignity attached to their profession, notwithstanding the degraded state in which operatives have ever been held by those who have lived on their ingenuity, and become enriched by their skill. But this state of things we believe is passing away, and the time is not distant when such men, instead of being deemed, as under the old regime, virtual serfs, will exert an influence in society commensurate with their contributions to its welfare. And where, it may be asked, is there a comfort, or convenience, or luxury of life, which they do not create or assist to furnish, from the bread that sustains the body, to the volume that informs the mind?

Few classes have a more honourable career before them than intelligent mechanics: certainly none have better opportunities of associating their names with those of the best of their species. Science and art open the paths to true glory; and greater triumphs remain to be achieved in both than the world has yet witnessed. Human toil has not been dispensed with; bnt it certainly will be superseded, in a great measure, if not altogether, by forces derived from inanimate nature. A great part of the globe is yet a desert, inhabited by beasts of prey, or by men more savage than they; whereas, the Creator designs the whole to be a garden, and peopled with happy intelligences, as in the first Eden. It is much too common to seek ephemeral distinction on the troubled sea of politics or party; but of the thousands who launch their bark upon it, how few ever reach the haven of their wishes! The greater part are soon engulphed in oblivion, while not a few, exhausted by useless struggles, are bereft of their energies, and quickly sink in despair; but no fame is more certain or more durable than that which arises from useful inventions. Whitney and Whittimore, Evans and Fulton, will be remembered as long as cotton gins, carding machines, steam-engines, and steam-boats, are known on these continents, and when contemporary politicians are wholly forgotten—in fact, most of these are so already. The name of Watt will be known when that of every warrior, and monarch, and statesman of his day has perished; and so it ought to be, for, with few exceptions, he contributed more to the happiness of his species than have such men from the beginning of time. No one is now interested in learning any thing respecting the sanguinary Bull of Burgundy, and his wily antagonist, the eleventh Louis of France, whose contests kept for years the European world in an uproar; and the latter, not content with murdering his species by wholesale, in his old age slew infants, that he might acquire new vigour by bathing in their blood; but as long as time endures the world will revere the names of their contemporaries—Gottenburg, Koster, Faust, and Schœffer, and their associates in printing and type-founding.

"Science and the arts are renovating the constitution of society. The destiny of nations cannot be much longer held by political gamblers, wealthy dolts, titled buffoons, and royal puppets; these, no longer sustained by factitious aids, must descend to their own level. Theories of governments will not be opposed to nature, and carried out in violation of her laws; but practical science will be the ruling principle; and practical philosophers will be, as God designed they should be, the master spirits of the world. The history and progress of the useful arts will soon become a subject of general study. Historians will hereafter trace in them the rise and fall of nations; for power and pre-eminence will depend upon new discoveries in, and application of, science. Battles will soon be fought by engineers instead of generals, and by mechanism in place of men. But battles, we trust, will hereafter be few; for if ever men were called upon by that which is dear to them and their race—by that which is calculated to raise the purest feelings and exterminate the worst ones—it is to denounce that spirit of military glory which encourages and induces offensive wars. Take away all the false glare and pomp of wars, and tyranny will expire, for it will have nothing to support it. Put war in its true light, and no well-regulated mind would ever embrace it as a profession."—Pref., p. v.

Of what sort the "remarks" are which have called for this prefatory justification, the reader may judge from the following extracts:—

Early History of the Arts.

"The SCHOLAR mourns, and the ANTIQUARY weeps over the wrecks of ancient learning and art—the PHILOSOPHER regrets that sufficient of both has not been preserved to elucidate several interesting discoveries, which history has mentioned; and to prove that those principles of science, upon which

the action of some old machines depended, were understood; and the MECHANIC inquires in vain for the processes by which his predecessors, in remote ages, worked the hardest granite without iron, transported it in masses that astound us, and used them in the erection of stupendous buildings, apparently with the facility that modern workmen lay bricks, or raise the lintels of doors. The machines by which they were elevated are as unknown as the individuals who directed their movements. We are almost as ignorant of their modes of working the metals, of their alloys which rivalled steel in hardness, of their furnaces, crucibles, and moulds; the details of forming the ennobling statue, or the more useful skillet or cauldron. Did the ancients laminate metal between rollers, and draw wire through plates, as we do? Or, was it extended by hammers, as some specimens of both seem to show?* On these and a thousand other subjects, much uncertainty prevails. Unfortunately, learned men of old deemed it a part of wisdom to conceal from the vulgar all discoveries in science. With this view, they wrapped them in mystical figures, that the people might not apprehend them. The custom was at one time so general, that philosophers refused to leave anything in writing, explanatory of their researches.

"Whenever we attempt to penetrate that obscurity which conceals from our view the works of the ancients, we are led to regret, that some of their MECHANICS did not undertake, for the sake of posterity and their own fame, to write a history and description of their machines and manufactures.

"We know that philosophers, generally, would not condescend to perform such a task, or stoop to acquire the requisite information, for they deemed it discreditable to apply their energies and learning to the elucidation of such subjects. (Few could boast with Hippias—who was master of the liberal and *mechanical* arts—that the ring on his finger, the tunic, cloak, and shoes which he wore, were the work of his own hands.) Plato inveighed with great indignation against Archytas and Eudoxus, for having debased and corrupted the excellency of geometry, by mechanical solutions, causing her to descend, as he said, from incorporeal and intellectual to sensible things; and obliging her to make use of matter, which requires manual labour, and is the object of servile trades.*

"To the prevalence of such unphilosophical notions amongst the learned men of old, may be attributed the irretrievable loss of information respecting the prominent mechanics of the early ages, those

> 'Searching wits,
> Who graced their age with new invented arts.'
> *Virgil, En.* vi. 900.

"Their works, their inventions, and their names, are buried beneath the waves of oblivion; whilst the light and worthless memorials of heroes, falsely so called, have floated on the surface, and history has become polluted with tainted descriptions of men, who, without having added one atom to the wealth or to the happiness of society, have been permitted to riot on the fruit of other men's labours; to wade in the blood of their species, and to be heralded as the honourable of the earth! And still, as in former times, humanity shudders, at these monsters being held up, as they impiously are, to the admiration of the world, and even by some Christians too, as examples for our children."

The Discoveries to be yet discovered.

"There is no truth in the observation of some people, that all discoveries of importance are already made; on the contrary, the era of scientific research and the application of science to the arts may be considered as but commenced. The works of creation will for ever furnish materials for the exercise of the most refined intellects, and will reward their labours with a perpetual succession of new discoveries. The progress which has been made in investigating the laws that govern the aqueous, atmospherical, mineral, and vegetable parts of the creation, is but a prelude to what is yet to be done; it is but the clearing of the threshold preparatory to the portals of the temple of science being thrown open to the world at large. There is no profession, however mature, no art, however advanced, that is not capable of further improvement; or that, so far as we can tell, will not always be capable of it. If an art be carried to the utmost perfection it is capable of in one age, discoveries in others will in time be made, by means of which it will be still further advanced; for every improvement in one has an effect, more or less direct, on every other.

"The benefits already derived from steam are but as a drop to the ocean when compared with those that posterity will realize; for if such great things have been accomplished by it in one century, what may not be expected in another, and another? It has been calculated that 200 men with ma-

* "And they did *beat the gold* into thin plates, and *cut* it into wires." Exod. xxxix. 3. These plates, were probably similar to those made by the ancient goldsmiths of Mexico, which were "three quarters of a yard long, foure fingers broad, and as thicke as parchment." Purchas' Pilgrimage. 984. "Silver *spread into plates*, is brought from Tarshish, and gold from Uphaz." Jer. x. 9.

* Plutarch's Life of Marcellus.

chinery moved by steam, now manufacture as much cotton as would require 20,000,000 of persons without machines; that is, one man, by the application of inorganic motive agents, can now produce the same amount of work that formerly required 100,000 men. The annual product of machinery in Great Britain, a mere spot on the earth, would require the physical energies of one half the inhabitants of the globe, or 400,000,000 of men; and the various application of steam, in different parts of the world, now produce an amount of useful labour, which, if performed by manual strength, would require the incessant exertions of every human being. Hence this great amount of labour is so much gained, since it is the result of inorganized forces, and consequently contributes so much to the sum of human happiness. Now, if such results have been brought about so quickly, and by steam alone, what may not be expected from it, and other aëriform fluids, in ages to come, when the progressive improvement of every art and every science shall have brought to light not only other agents of the kind, but more efficient means of employing them? There is no end to the beneficial application of the gases as motive agents, and no limits to the power to be derived from them. As long as rain falls, or rivers flow, while trees (for fuel) grow, or mineral coal is found, man can thus wield a power that renders him almost omnipotent."

The remainder of our extracts shall be from the more technical portions of the work.

Atmospheric Sprinkling Pots.

"The retention of water in *inverted* vessels while air is excluded from them, could not have escaped observation in the rudest ages. Long ere natural phenomena had awakened curiosity in the human mind, or roused the spirit of philosophical inquiry and research, it must have been noticed. When a person immerses a bucket in a reservoir, and raises it in an inverted position, he soon becomes sensible that it is not the weight of the vessel merely which he has to overcome, but also that of the water within it; and not till the mouth emerges into air do the contents rush out and leave the bucket alone in his hands. This is one of those circumstances that has occurred more or less frequently to most persons in every age. It would be absurd to suppose that the groups of oriental females, who, from the remotest times, have assembled twice a day to visit the fountains of rivers for water, did not often perform the experiment, both incidentally and by design. They could not in fact plunge their water pots (which were often without handles) into the gushing fount without occasionally repeating it; nor could Andromache and her maids fill buckets to water the horses of Hector, and daily charge pitchers in the stream for domestic uses, without being sometimes diverted by it. But the phenomenon thus exhibited was not confined to such occasions; on the contrary, it constantly occurred in every dwelling. An ancient domestic, like a modern housemaid, could hardly wash a cup or rinse a goblet by *immersion*, without encountering it. Besides the vessels named, there were others that formed part of the ordinary kitchen furniture of the ancients, the daily use of which would vary and illustrate it. These were long-necked and narrow-mouthed vases and bottles, that retained liquids when inverted like some of our vials. Others were still further contracted in the mouth, as the *ampulla*, which gave out its contents only by drops. To the ordinary use of these vessels, and to incidental experiments made with them, may be traced the origin of our *fountain* lamps and inkstands, bird fountains, and other similar applications of the same principle.

"The suspension of a liquid in inverted vessels by the atmosphere was therefore well known to the early inhabitants of the world, whether they understood the reason of its suspension or not; and when in subsequent times philosophers began to search into causes and effects, the phenomenon was well calculated to excite their attention, and to lead them to inquiries respecting air and a vacuum: it is probable that it did so, for the earliest experiments on these subjects, of which we have any accounts, were similar to those domestic manipulations to which we have alluded, and the principal instrument employed was simply a modification of a goblet inverted in water. This was the atmospheric '*sprinkling pot*,' or 'watering siphon,' which is so often referred to by the old philosophers, in their disputes on a *plenum* and a *vacuum*. It has long been obsolele, and not having been noticed by modern authors, few general readers are aware that such an instrument was ever in use, much less that it formed part of the philosophical apparatus of the ancient world.

"The interesting associations connected with it and its modifications entitle it to a place here. Indeed were there no other reason for attempting to preserve it a little longer from oblivion, than that indicated at the close of the last paragraph, we should not feel justified in passing it by. It is moreover, for aught that is known to the contrary, the *earliest* instrument employed

in hydro-pneumatical researches. Its general form and uses may be gathered from the remarks of Athenagoras respecting it. This philosopher, who flourished in the fifth century B. C., made use of it to illustrate his views of a vacuum. 'This instrument (says he), which is acuminated or pointed towards the top, and made of clay or any other material, (and used as it often has, for the watering of gardens) is in the bottom very large and plain [flat] but full of small holes like a sieve, but at the top has only one large hole.'* When it was plunged in water, the liquid entered through the numerous holes in its bottom; after which the single opening at top was closed by the finger to exclude the air; the vessel and its contents were then raised, and the latter discharged at pleasure by removing the finger.

"As this was the ancient *garden* pot of the Greeks, Pliny probably refers to it when he speaks of 'sprinkling' water, oil, vinegar, &c. on plants and roots.† It appears to have been continued in use for such purposes in Europe, through the middle ages; and to a limited extent up to the 17th and 18th centuries.‡ Figures of it are, however, rarely to be met with, for it seems to have been nearly forgotten when the discovery of Torricelli revived the old discussions on a vacuum; and though Boyle and others then occasionally referred to it, few, we believe, gave its figure.§ Montfaucon speaks of examining an ancient 'watering stick,' and also a 'sprinkling pot;' but unfortunately he has not described either.‖ Of a great number of old philosophical works, that we have examined for the purpose of obtaining a figure, we met with it only in Fludd's works."

Invention of the Atmospheric Pump.

"It is uncertain when or by whom the common atmospheric pump was invented. It is supposed to have been known to the old Egyptians, and to have been used in the ship in which Danaus and his companions sailed to Greece.** As the *antlia* of the Greeks, it could not have originated with Ctesibius, to whom it has sometimes been attributed, since it or some other machine or device is mentioned under that name, by Aristophanes and other writers who flourished ages before him.†† There are other indications that it was previously known, for either it or something very like it is mentioned under the name of a *syphon*. This term, it is known was a generic one, being applied to hollow vessels, as funnels, cullenders, pipes; and generally to instruments that either raised or dispersed water, as syringes, catheters, fire-engines, sprinkling-pots, &c.* That the machine to which we refer raised water by 'suction,' is apparent from ancient allusions to it. According to Bockler, 'the Platonic philosophers asserted that the soul should partake of the joys of heaven as through a siphon;' and by it Theophrastus explained the ascent of marrow in bones; and Columella the rise of sap in trees. In these instances, it is obvious that neither the ordinary syphon nor the syringe could be intended, but the atmospheric pump; a machine that Agricola described as a syphon; and one to which the remark of Switzer only can apply—'the syphon was undoubtedly the chief instrument known in the first ages of the world, (besides the draw-well,) for the raising of water.'

"Nor is there anything in the account given by Vitruvius of 'the machine of Ctesibius,' which indicates that the atmospheric pump was not in previous use. His description is obviously that of a *forcing* pump, (and appears to have been so understood by all his translators,) one whose working parts were placed not above but in the water it was employed to elevate; whose piston was solid, and which by means of pipes forced the water *above itself;* that raised the water 'very high;'—attributes which do not belong to the common pump. It is true he has not mentioned the latter, perhaps because it was not then employed as now in civil engineering, and therefore not within the scope of his design in writing his work. The manner in which Pliny speaks of it shows that it was an old device in his time, since it was one with which even country-people or farmers (the last to adopt new and foreign inventions) were familiar. In his 19th Book, 'On Gardens,' cap. 4, he observes: when a stream of water is not at hand, the plants should be watered from tanks or wells, the water of which may be drawn up by plain poles, hooks and buckets, by swapes or cranes [windlass], 'or by *pumps* and such like.' And that these were no other than the old wooden pump of our streets, and such as our farmers use, is obvious from a passage in his 16th Book, cap. 42, where speaking of the qualities and uses of different kinds of wood, he remarks, 'pines, pitch trees, and allars, are very good to make PUMPS and conduit pipes to convey water; and for these purposes their wood is bored hollow.'

"Although sufficient time may be supposed to have elapsed from the age of Ctesi-

* As quoted by Switzer from Bockler, Hyd. 167.
† Nat. Hist. xvii. 11 and 28; xix. 12; and xv. 17.
‡ Dictionnaire De Trévoux, Art. Arrosoir.
§ Boyle's Philosophical Works, by Shaw, Lon. 1725. Vol. ii. pp. 140, 144.
‖ Italian Diary, Lon. 1725, 295.
** See Edin. Encyc. Art. Chronology, vol. vi. 263.
†† Robinson's Antiquities of Greece, cap. 4. On Military Affairs.

* See Ainsworth's Dict.

bius to that of Pliny for the introduction of the atmospheric pump to the countrymen of the latter (supposing it to have been invented by the former), we can hardly believe, if it were not of more remote origin, that it could even in that time have found its way into Roman farm-yards and gardens; much less that it should have superseded, (as it appears to have done,) every other device on board of their ships. New and foreign inventions were neither circulated so easily nor adopted so readily in ancient as in modern days; and even now a long time would elapse before inventions of this kind would find their way through the world, and longer before they became generally adopted. But had the pumps of which Pliny speaks been of recent introduction, he would certainly have said so; and had they been the 'water forcers' of Ctesibius, to which he alludes in his 7th Book, he could scarcely have avoided recording the fact."

Origin of Safety-valves.

"It should not be supposed that safety-valves were wholly unknown before Papin's time; on the contrary, they were frequently used, although this fact has not been noticed by any writer on the steam-engine. The liability of stills and retorts to be rent asunder led old chemists to apply plugs to openings in those vessels, that the vapour might raise or drive them out, and escape ere its tension exceeded the strength of the vessels: such were the plugs in ancient steam deities, see page 399. In some old works on distilling, conical plugs or valves are shown as fitted into cavities on the tops of boilers, and in some cases they were loaded. In the '*Maison Rustique* de Maistres Charles Estienne et Jan Liebault, Docteurs en Medecine,' Paris, 1574, folio 196, 197, are figures of two *close* boilers, in which the distilling vessels were heated: one formed a water, the other a vapour bath. On the top of each is a conical valve opening upwards. These served both to let out the superfluous steam and to introduce water. Glauber, who contributed several valuable additions to the mechanical department of chemistry, has figured and described, in his Treatise on Philosophical Furnaces, the modes by which he prevented glass retorts or stills from being burst by the vapour. A long stopple or conical valve was fitted to the neck of each, being ground air-tight to its seat, and loaded with a 'cap of lead,' so that when the steam became too 'high' it slightly raised the valve, and a portion escaped; the valve then closed again of itself, 'being pressed down with the leaden cap, and so stopt close.' (English Translation, Lond. 1651, p. 306.) The valve on Newcomen's first engine was of this description. In the same work Glauber describes the most philosophical of all safety-valves, viz., a column of mercury enclosed in a bent tube which communicates with the boiler or still, somewhat like the modern mercurial gauge. He also describes that beautiful modification of it known among chemists as the water lute, or quicksilver lute: that is, around the mouth or neck of a vessel a deep cavity is formed and partly filled with water or mercury, as the case may be. A cylindrical vessel, open at top and closed at the bottom, forms the cover: it is inverted, the open end being placed in the cavity and dipping as far into the liquid as the internal pressure may require. In 'The Art of Distillation, or a Treatise of the choicest Spagyrical Experiments,' &c., by John French, Doctor of Physic, Lond. 1651, the author describes the same devices for preventing the explosion of vessels as those mentioned by Glauber. Speaking of the action of such safety-valves he observes, (page 7) "upon the top of a stopple [valve] there may be fastened some lead, that if the spirit be too strong, it will only heave up the stopple and let it fall down again.' Papin's claim therefore is not to the valve itself, but to its improvement, or rather to the mode of applying it by means of a lever and moveable weight; thereby not only preventing the valve from being blown entirely out of its place, but regulating the pressure at will, and rendering the device of universal application."

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

WILLIAM FAIRBAIRN, OF MANCHESTER, ENGINEER, *for certain improvements in the construction of metal ships, boats, and other vessels, and the preparation of metal plates to be used therein.*—Patent dated, July 6, 1842; Specification enrolled January 6, 1843.

The plates are so rolled or constructed, as to be perfectly smooth on that side which is to become the outer side of the vessel, but along the two inside edges of the plate there are raised two bands or strips varying in breadth, according to the thickness of the plate, and of course, the strength of rivet to be used in joining them. The plates are to be punched in the usual way, and afterwards counter sunk on the outside. In joining, the plates are brought edge to edge, being flush on the outside; and upon the inside is laid a piece of flat bar iron pierced with two lines of rivet holes, so as to correspond with the holes in the plate, to which

it is to be riveted. Where it is required to have greater strength, so as to resist increased external pressure, the flat bar has a raised feather along its outer side, the section of which will form that of a **T**. The bands, or strips, along the edges of the plates are to be of such thickness as to make the plate of uniform strength throughout when pierced for the rivets; and thus to obviate the risk of the plates being broken in that part, which is generally, if not always found to be the result in cases of concussion, &c. The rivets are so made as to fill the countersink, and thus present an uniform smooth surface on the outside of the vessel when completed, which of course must meet much less resistance in passing through the water.

The claim is to the manufacturing of plates and joining them as above mentioned in the construction of boats and other vessels.

WILLIAM REVELL VIGERS, OF RUSSELL-SQUARE, ESQUIRE, *for a mode of keeping the air in confined places in a pure or respirable state, to enable persons to remain or work under water and other places, without a constant supply of fresh atmospheric air.* (Being a communication.) Patent dated July 7, 1842. Specification enrolled January 7, 1843.

The invention which is the object of this patent, is that already so well known to the public as that of Dr. Payerne, on whose behalf and his own, the patent has been taken out by Mr. Vigers.

The first thing claimed and specified is the depriving of the atmosphere in confined places of the carbonic acid gas which it contains, produced from respiration or combustion, by means of quick lime and caustic alkali, or of the lime alone, which is to be dissolved in eight times its weight of water. The air in the apartment is to be passed through this caustic solution by a pair of bellows, the nozle of which reaches nearly to the bottom of the vessel containing the lime and water. The vitiated air thus coming in contact with the lime, the carbonic acid gas is absorbed. It is calculated that one cubic foot of atmospheric air must be purified for each person per minute.

2. The patentee claims the restoring the requisite quantity of oxygen, to supply the place of that consumed; which oxygen is to be procured from the cloride of potash, or driven off from the peroxide of manganese by means of heat, into the apartment or allowed to escape from vessels into which it may have been previously compressed.

3. The patentee claims further, the purification of the air contained in the diving-bell, by the process described in claim 1, and the restoring the requisite proportion of oxygen from a vessel attached to the diving-bell, into which the oxygen had been previously compressed; also the allowing the escape of atmospheric air, which had previously been compressed several atmospheres into two compartments, one of which is situated at each end of a diving-bell, somewhat resembling a boat inverted, the centre one being occupied by the diver or workmen, who may, by means of stop-cocks, regulate the supply according to their wants.

The specification is of extraordinary length, filling no less than ten skins of parchment, but the above extract contains all that is material in it.

CHARLES ROBERT AYERS, OF JOHN-STREET, BERKELEY-SQUARE, ARCHITECT, *for improvements in ornamenting and colouring glass, earthenware, porcelain, and metals.* — Patent dated July 23, 1842; Specification enrolled January 23, 1843.

If the surface of the glass, earthenware, &c. is to be covered with a plain ground, it is first to be coated with some adhesive substance, such as essence of lavender. A piece of net, or other thin tissue, is then laid over the article, which is to be dusted over with the colouring matter in the state of fine powder. The colouring matter, passing through the holes of the tissue, attaches itself to the adhesive coating. The tissue is then to be removed, and the article submitted to the action of the fire, taking care, in the case of metals, not to bring them to a red heat, as the colour is more easily fixed thereon than on earthenware, porcelain, &c. When the articles are to be ornamented with figures, &c., they are first coated with the adhesive substance, and covered with net, or other tissue, as before. Stencil plates, made of paper, or any other convenient substance, in which the figures have been cut out, are then laid above the tissue, and the colours dusted on; after which, *without taking off the net, paper, &c.*, the goods are subjected to the firing process. Another method of ornamenting such goods, described by the patentee, consists in having the figures cut in blocks similar to woodcuts, which are covered with turpentine varnish, and impressed on the article to be ornamented, which is then dusted with the colour or colours, and fixed as in ordinary cases.

Claims.—1. The patentee does not claim the application of colour to earthenware, &c. in a state of powder, but its application in a state of powder, with net, or other tissue intervening.

2. The application of stencil plates of various figures, as above described.

3. The impressing the figures or ornaments by means of blocks, and then dusting on the colour.

Thomas Bell, of Saint Austle, Cornwall, Mine Agent, *for improvements in the manufacture of copper.* Patent dated July 29, 1842. Specification enrolled January 29, 1843.

The ore is passed through a sieve having four meshes to the inch; it is then put in to hoppers over an aperture formed in the top of the roasting furnaces, into which it is allowed to pass by withdrawing the slide. The ore having been mixed with about $\frac{1}{20}$th part (more or less, according to the nature of the ore,) of lime, or other calcareous substance, is then spread evenly over the bottom of the furnace to be subjected to the action of the fire. Mr. Bell makes use of a double furnace or furnace of two chambers, one opening into the other; the fire is applied at the end of the first, and the gases, &c. evolved, escape at the outer end of the second. When the ore has been sufficiently roasted, being then in a molten state, the upper part is raked off, but that beneath being in a more refined state, is to be drawn off by tapping the side of the furnace. The metal in this state is then to be broken into pieces of 10 or 12 pounds weight, and placed in a heated cupola along with coke or charcoal, and a small quantity of lime or other calcareous matter, taking care to arrange matters so as to have always one column of coke up through the centre. The cupola is worked by any of the common methods, and the blast may be either cold or hot. As the molten metal runs out from the tap hole at the bottom of the cupola it passes over a box containing sand, into which the finer part of it is deposited; the remainder, flowing over, falls into a trough of water, which is kept constantly cool by a feed pipe. The metal precipitated into the cold water is broken up and reduced to a fine granulated state, after which it undergoes the process of jigging, by which it is separated from all earthy particles, &c.

The advantages of this process are stated to be—1st, time saved; 2nd, economy in fuel; 3rd, saving in the expense of furnaces; 4th, increased quantity of granulated metal obtained from a given quantity of ore.

The patentee's claim is not to any part of the process separately, but to the combination of the whole in the manner before described.

NOTES AND NOTICES.

Registration of designs.—The calico printers have made a present of 3,000 ounces of plate to Mr. Emerson Tennant, M. P., for his successful exertions in procuring the passing of the last Copyright of Designs Act. At a public dinner given on the occasion at Manchester; Mr. Tennant stated "that, during the five months previous to the enactment of the New Bill for the more effectual protection of Designs, the number of patterns of all kinds for carpets, silks, shawls, and paper-hanging, amounted to but 53, but that the number of the same description of designs, registered in the five months since, had been no less than 425. But, in addition to goods of this class, printed designs upon cotton had now, for the first time, been admitted to register; and of these alone there had been deposited since the passing ot the Act no fewer than 2,356. Its success, however, was still more apparent in the remarkable fact, that, whilst during the three years' existence of the former law, there were registered of every description of articles, metals included, but 1,421 designs; there had already been registered, within four months and three weeks since the passing of the measure, no fewer than 2,934 under the system which he had had the honour to introduce."

Natural Gas Lights.—So abundant is light carburetted hydrogen gas in some of the northern mines, that to procure a natural gas light, a small hole a few inches deep has only to be made in the coal, and a tube inserted, when the gas discharges through it so freely as to enable it to be lighted at the end. At Wallsend Colliery (c. pit,) there has been *for many years* an universal discharge of gas, which burns at the pit mouth with a bright light that is visible for miles. It is conveyed in metal pipes from a single goaf or reservoir, of not more than five acres, into which it pours 280 yards below the surface, and 2,000 from the shaft. Day and night it continues to discharge at the rate of five one-fifth hogsheads per minute, and six years ago was more than double that amount.—*South Shields Report on Accidents in Mines.*

Explosions of Fire-damp on board of Collier Vessels.—On August the 5th, 1816, the ship *Flora*, of London, having just taken a cargo of coals on board in Sunderland harbour, blew up with a terrible explosion; the deck beams were broken, and the decks torn up. On July 4th, 1817, the *Fly*, of Ely, lying at Brandling staith, on the Tyne, with a cargo of coals, just taken in, the gas from it exploded, burnt the captain in the cabin, tore up part of the deck, threw a boat from the hatches, and did other serious damage. Upon the 21st July, 1839, the sloop *Enterprise*, when at sea, with coals from Pembroke to Newport, Isle of Wight, had an alarming explosion, which fortunately only frightened, but did not injure the crew. And the schooner *Mermaid*, of Guernsey, upon the 29th August, this year, (1842), lying at South Shields, sustained an explosion: she had been laden that day with Hilda coals, and the hatches immediately battened down; when six hours after, the gas from the coal exploded at the forecastle lamp, one man was knocked down and much burnt in the face, another injured, the mate struck down in the cabin, and a hatch started. A circumstance not undeserving of notice, lightning, in great abundance, was playing in the atmosphere all around the vessel at the time.—*South Shields Report.*

How long will the Coal Fields of Great Britain last?—According to Conybeare and others of our abler geologists, 2000 years at least. But Sedgwicke and Buckland say that "400 years will leave but little more than the name of our best seams." And the South Shields Committee, in their recent report on accidents in mines, not only concur in this opinion, but describe the Tyne portion of our great northern coal field as beginning already to experience the difficulties of *exhaustion* in the finer descriptions of coal. "Of an abundant supply of coal from other parts of the world, however, when our own mines are exhausted there appears to be no fear; for France, Belgium, Saxony, Bohemia, Silesia, Russia, Syria, the East Indies, China, Australia, and the United States, are all mentioned as being rich in this valuable mineral. English coal is now sold at the coasts of France and America at a profit;" but this arises, in the opinion of the South Shields Committee, solely from the want of capital in these countries to work their own mines to advantage; a state of things which it is not reasonable to expect can always continue.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1020.] SATURDAY, FEBRUARY 25, 1843. [Price 3*d*.

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WOOLRICH'S PATENT PROCESS OF MAGNETO-PLATING.

Fig. 1.

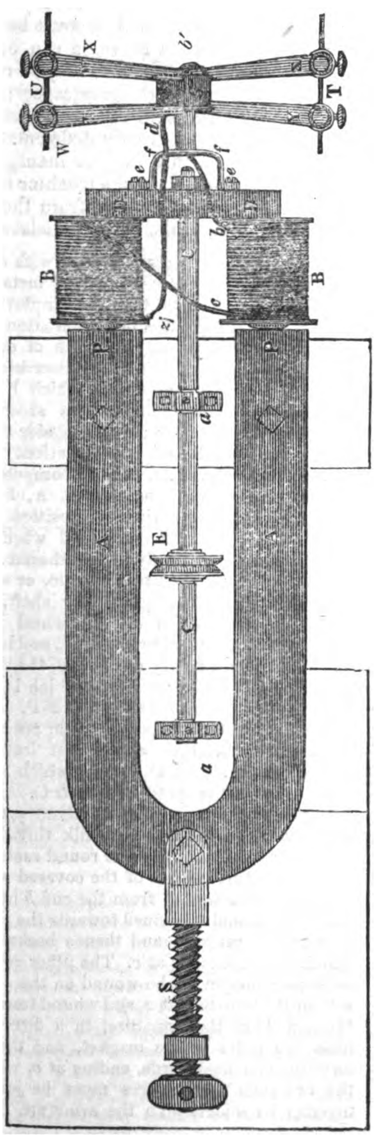
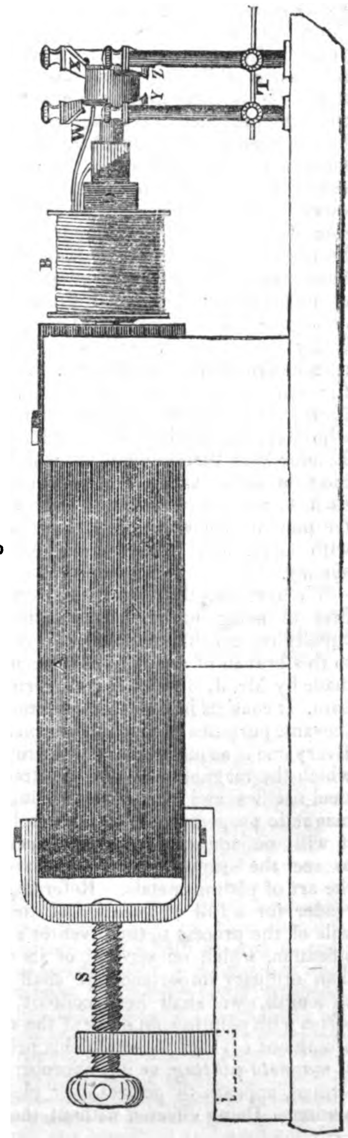


Fig. 2.



WOOLRICH'S PATENT PROCESS OF MAGNETO-PLATING.

[Patent dated August 1, 1842; Specification enrolled February 1, 1843.]

Among the discoveries in connexion with the mechanical arts which have been made within the last four years, the most extensively valuable are undoubtedly those relating to the coating of one metal with another metal—as copper with gold, tin with silver, &c., by galvanic precipitation. They have already gone far to supersede entirely the older and more mechanical methods of gilding, silvering, and plating. Since Mr. Spencer first led the way, with so little pecuniary advantage to himself, he has been followed by a host of fellow-labourers—each striving to appropriate either the titular proprietorship or the more profitable usufruct, of some portion of the new field of invention which he laid open to their enterprize. Patents have been taken out for a great number of modes of precipitation, differing more or less from one another, but all coming under the now universally accepted denomination of Electro-Plating. Among the more prominent and successful of these patentees are the Messrs. Elkington, who have established manufactories in London and Birmingham, at which the most beautiful articles of manufacture, such as vases, candelabra, tea-urns, coffee-pots, dish-covers, &c. &c. are plated with silver and gold by the galvanic agency.

We have now the pleasure of being the first to bring under public notice an equally remarkable application of science to this branch of art which has been just made by Mr. J. S. Woolrich of Birmingham. It consists in the accomplishment of the same purposes by means of *magnetism.* Every one is acquainted with the property which the magnet possesses of attracting steel needles and of communicating the magnetic property to iron and steel, but it will, no doubt surprise most persons to see the same power employed in the art of plating metals. Referring the reader for a full explanation of the details of the process to the inventor's specification, which on account of its more than ordinary importance we shall give at length, we shall here content ourselves with pointing out some of the more prominent advantages which this process of *magneto-plating*, as it is appropriately termed, appears to possess over electro-plating. Being effected without the aid of galvanism—neither acids nor salts are employed, and there is no wear and tear of galvanic batteries. In fact, when the apparatus is complete, the cost of which is moderate, it will last for an almost unlimited period of time; for as there is no destruction in working it, of any of its parts, except by friction, it must be long before any renewal of them can be required. The apparatus too, may be relied on for working with the greatest certainty and regularity, in both which respects the galvanic battery is greatly deficient. The facility with which it may be managed is also remarkable—the same machine being capable of plating articles from the size of a pin's-head to that of a candelabra.

"My improvements in coating with metal the surface of articles formed of metal, or metallic alloys, consist in the employment of a magnetic apparatus in combination with metallic solutions, and my mode of operation is hereinafter particularly described.

"The magnetic apparatus which I have employed for that purpose, is shown in fig. 1, which is a plan; fig. 2, a side elevation; and fig. 3, an end elevation. The magnetic apparatus, is, in part composed of a compound horse-shoe magnet A, figs. 1 and 2, placed in a horizontal position, on a wooden platform, or table, and when adjusted, it must be firmly affixed thereto. An armature D D is fixed to a spindle, or shaft, C C (fig. 1). The spindle, or shaft, revolves in bearings *a a*. A wheel E is fixed upon the spindle, or the shaft, and is employed to give a rotary motion to the shaft, and of course to the armature, which is thus made to revolve before the poles P P, of the magnet A A, figs. 1 and 2. The armature is made by bending a flat soft iron bar (shown at fig. 4, E D, D E,) which must be attached to the spindle, or shaft C. About fifty yards of copper wire of about $\frac{1}{16}$th of an inch thick, covered with silk thread, is wound in a spiral direction round each end of the armature. One of the covered wires is begun to be wound from the end *b* of the wire, fig. 1, and continued towards the poles P P of the magnet, and thence backwards and forwards, ending at *c*. The other covered wire is begun to be wound on the other side of the armature at *z*, and wound towards the end D of the armature, in a direction from the poles of the magnet, and thence forwards and backwards, ending at *c*, where the two ends of the wires must be joined together by solder. To the armature D, I

affix by two screws *e e*, what I call a divider, which is shown of the real size at figs. 6, 7 and 8. The divider is composed of a brass tube *y*, at one end of which is riveted a piece of brass *f*, as a means of affixing the divider to the armature, as shown at fig. 1. At the other end a cylinder of box-wood *g*, is affixed. A piece of copper of the form shown at *h*, fig. 8, is screwed to each end of the cylinder of box-wood, and it will be seen by examining figs. 7 and 8, that each piece of copper *h h* is rather less than a semicircle. One end *d* (fig. 1) of covered copper wire is connected to the piece of copper at one end of the cylinder of box-wood, and the end *b′* of wire *b* (fig. 1), is connected to the piece of copper at the other end of the cylinder of box-wood. Four brass springs, W X Y Z, are attached by screws to the upper parts of four brass pillars, each pillar being fixed at its bottom end into a wooden table, or platform, upon which the compound magnet is fastened, as before mentioned. These springs are so adjusted, that while two of the springs, W and Z, are pressing on the two pieces of copper *h h* (one of which pieces of copper is affixed to one end of the cylinder of box-wood, and the other piece of copper to the other end of the cylinder of box-wood, in the manner before described,) the other springs, X and Y, are pressing on the cylindrical surface of the box-wood, and *vice versa*. Near the bottom end of each pillar a hole is drilled, and

Fig. 3.

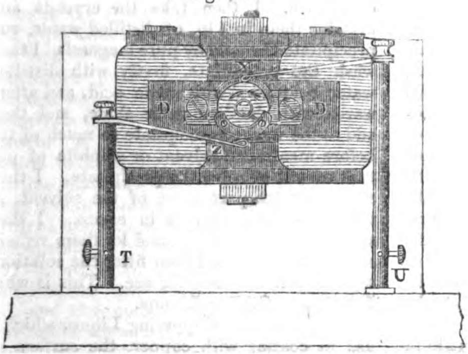


Fig. 4.

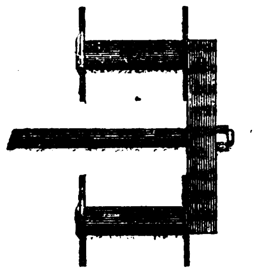


Fig. 7.

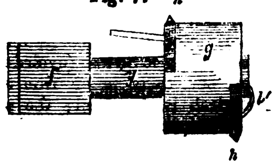


Fig. 5.

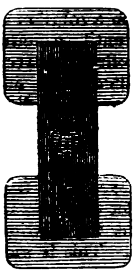


Fig. 6.

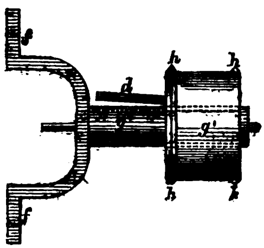
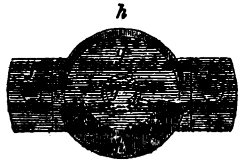


Fig. 8.



a piece of copper wire of about $\frac{1}{10}$th of an inch in diameter is passed through the holes of the two pillars on each side of the divider, and is secured to each pillar by a binding screw, as shown at T, figs. 1, 2 and 3, and at U, figs. 1 and 3.

"When I desire to coat with metal the surface of articles formed of metal, or metallic alloys, I place an earthenware vessel containing a solution (prepared as hereinafter described,) as near as may be convenient to the wires T and U.

"The article to be coated with metal should be well cleaned, and then should be brought into contact with the wire T, and a plate of metal, similar to the metal of which the metallic solution is partly composed, must be brought into contact with the wire U.

"The article to be coated with metal must be immersed in the solution contained in an earthenware vessel, and the plate of metal connected to the wire U should be previously, either wholly, or partially immersed in the solution, the portion of the superficies of the

plate to be immersed depending upon the relation of the same to the superficies of the article to be coated; care must be taken that the article to be coated with metal, and the metal plate, do not touch, though they should be placed near to each other.

"A screw S (fig. 1) is used to adjust the distance between the poles P P of the magnet, and the ends of the armature D.

"The magnetic apparatus being in the position shown in the engravings, figs. 1, 2 and 3, and all other things being adjusted as hereinbefore mentioned, rotary motion is communicated by a band to the wheel E, and consequently, to the shaft C C (fig. 1), and to the armature D D, and to the coils of covered wire B B, and also to the divider G. I have generally given to the shaft C C, about 700 complete revolutions per minute, and the distance between the ends of the armature and the poles of the magnet may vary from 3 inches to 100th part of an inch, the latter being the nearest practicable distance for revolution. The weight of metal deposited in a certain time on the surface of articles formed of metal or metallic alloys, will vary as the distance varies between the ends of the armature and the poles of the magnet; the weight of metal deposited will also vary as the number of revolutions of the armature varies, and also with the weight of the metal contained in a given volume of the metallic solution in which the article to be coated is immersed.

"The solutions which I use are made in the following manner: I take of the best pearlash of commerce 28 lbs. (avoirdupois) and add to it 30 lbs. (avoirdupois) of water, and boil them in an iron vessel until the pearlash is dissolved; the solution should then be poured into an earthenware or other suitable vessel, and suffered to stand until the liquor becomes cold. It should then be filtered, and 14 lbs. (avoirdupois) of distilled water added thereto; sulphurous acid gas (obtained by any of the known processes) should then be passed into the filtered liquor until it is saturated, taking care not to add sulphurous acid gas in excess. The liquor should be again filtered, and the liquor so filtered is what I term the solvent, or sulphite of potash.

"To make the Silvering Liquor which I use in coating with silver the surface of articles formed of metal or metallic alloys, I dissolve 12 oz. (avoirdupois) of crystallized nitrate of silver in 3 lbs. of distilled water (in a clean earthenware vessel), and add to the solution, by a little at a time, the before-mentioned solvent, so long as a whitish coloured precipitate is produced (care being taken not to add more of the solvent than is necessary). After the precipitate has subsided, I pour off the supernatant liquor, and wash the precipitate with distilled water. To the precipitate I add as much of the before-mentioned solvent as will dissolve it, and afterwards add about ⅛th part more of the solvent, so that the solvent may be in excess; I then stir them well together and let them remain about 24 hours, and then filter the solution, when it will be ready for use. This is what I designate Silvering Liquor.

"To make the Gilding Liquor which I use in coating with gold, the surface of articles formed of metal or metallic alloys, I dissolve 4 oz. (troy) of fine gold in a mixture of 11 fluid oz. of nitric acid (specific gravity 1·45), and 13 fluid oz. of muriatic acid (specific gravity 1·15), and 12 fluid oz. of distilled water: I then evaporate the solution and crystallize. I then take the crystals and dissolve them in 1 lb. of distilled water, and precipitate the gold by pure magnesia. I then wash the precipitate, firstly with distilled water acidulated with nitric acid, and afterwards with distilled water alone, and then add to the washed precipitate so much of the before-mentioned solvent or sulphite of potash as will dissolve the precipitate. I then add about ⅛th part more of the solvent, so that the solvent may be in excess. I then stir them well together, and let them remain about 24 hours, and then filter the solution, when it will be ready for use. This is what I designate Gilding Liquor.

"To make the Coppering Liquor which I use in coating with copper, the surface of articles formed of metal or metallic alloys, I dissolve 7 lbs. (avoirdupois) of the crystals of sulphate of copper, in 30 lbs. of distilled water, and add to this solution a solution of carbonate of potassa in water until precipitation ceases; I then filter and collect the precipitate and wash it with distilled water, and put it in a clean earthenware vessel; I then add to it as much of the before-mentioned solvent as will dissolve the precipitate, and afterwards add ⅓rd more of the solvent, so that the solvent may be in excess; I then stir them well together, and let them remain about 24 hours, and then filter the solution, when it will be ready for use. This is what I designate Coppering Liquor.

"The thickness of metallic coating to be deposited on the article intended to be coated, will depend on the time during which the article is submitted to the operation of the magnetic apparatus and solution; a thin coating will be deposited in a few seconds, whilst to obtain a thick coating, the article must be submitted to the constant operation of the magnet and solution for several hours. To adjust the magnetic apparatus for operation, it will be requisite to ascertain which of the two copper wires, T and U, should be

connected to the article to be coated. I ascertain it as follows: I put the magnetic apparatus in motion, and then pass the ends of both the copper wires T and U into water acidulated with sulphuric acid, when, if the magnetic apparatus is in proper working order, gas will be given off at one of the wires only, to which wire I connect the article to be coated, and I connect the other wire to a metal plate as before described. When the surface of the article to be coated is not of metal or metallic alloys, I give to it a metallic surface by rubbing plumbago upon it, and I then coat with metal the plumbago surface by the method before described.

"The distance at which the poles of the magnet should be placed from the ends of the armature, will depend upon the superficies of the article to be coated; the larger the superficies of the article the nearer must the magnet be placed to the armature, and the smaller the article, the greater must the distance be increased, the distance being inversely as the superficies of the article to be coated. If the surface of the article to be coated with metal, becomes, while in connexion with the magnetic apparatus of a brownish or darkish appearance, or if gas be evolved from the surface of the article during the operation, the magnet must be adjusted by the screw S, fig. 1, so as to increase the distance between the poles of the magnet and the ends of the armature, until the metal contained in the solution is properly deposited."

JEFFERY'S CEMENT — IMITATION CAOUTCHOUC — LIGHTNING CONDUCTORS — WOOD PAVING, ETC.

Sir,—In your last Number (1018) there is a letter from Mr. John Joiner, on the subject of Jeffery's marine glue, to the remarks on which I, in great part, agree. I take blame to myself for not having sooner communicated with you on this subject, as it is several months since the first exhibition of the cement in question at Woolwich. But many *remoræ* paralyze my actions and exertions.

I have for many years past been induced to experiment on the best mode of making cement, to join wood, glass, china, &c. Amongst other works, I had to "glue" the parts of my artificial shafts for my apparatus for flying in the air *by purely mechanical means*, in which I so far succeeded, as to form shafts 24 feet long, and weighing only 3 lbs., that would support my weight suspended from the middle. This was in 1824.

I also endeavoured to form a cement much stronger than glue, and indissoluble in water, for joining parts of fishing-rods, dozens of which I have made for my own use, far superior to those of the trade. White of egg and oyster-shell lime make a very good cement, but the best was a basis of shell-lac. *This I united with another substance*; and that you, as well as Mr. Joiner, may judge of its adhesive power, I will mention a fact. In 1833, I purchased a huge globular bottle called a tarboise, for the purpose of forming it into a vase, in which to keep gold and silver fish. To suit it for this purpose, it was necessary to cut off the neck, so as to form an aperture of, at least, 6 inches diameter. This I accomplished in the well-known way of winding round it several turns of string soaked in spirits of turpentine, then setting the string on fire, and throwing on it a bucket of cold water, when the flame is about to expire. The separation instantly takes place cleanly where the string was burning. But in this case, I used too much turpentine; some drops ran down the sides and caused several vertical cracks. To remedy this error, I wound round the upper edge of the glass globe a long piece of silk ribbon, steeped in the compound shell-lac cement I above allude to. The vase remained exposed to the weather and rain during two months in my garden, but I observed that the ribbon firmly adhered. I took it into my head to try its state upon the glass. Upon tearing off a part that touched the glass, numerous scales of glass were brought away, and adhered to it like scales upon a fish!!

I then placed a joint of a fishing-rod, joined with this cement, in a water-butt. After a week's immersion the cement was as firm as ever, without any binding over the joined part, or any varnish.

So much for marine cement—except, that I must say, that shell-lac will not do *alone*. Its tenacity is wonderful in a *straight* pull, but as your intelligent correspondent, Mr. Joiner justly remarks, it is somewhat "too brittle." I have opened many a well-corked bottle of wine with a stick of sealing-wax; but if the pull be not quite vertical, the connexion breaks.

It is well known that India-rubber, when once dissolved, *merely by heat*, will

never again solidify, but remain a clammy tar-like substance, without any power of adhesion. I endeavoured to combine caoutchouc with shell-lac—but did not succeed to my wish, probably from lack of manipulative skill and other means. *But the composition which I have above alluded to, which pulls scales off a glass bottle, and is unaffected by the rain for many weeks, will do for all the purposes that I can think of.*

For the amusement of your chemical readers, I will mention that I have made an artificial caoutchouc, which in *appearance and elastic feel* cannot be distinguished from the real, but it is not *quite* insoluble in water. It is thus: dissolve an equal weight of glue in as much treacle over a mild fire in an iron vessel; then add the like weight of linseed oil. This mixture will soon amalgamate, and the product will be such in appearance and elasticity, as to make any body swear that it is caoutchouc.

To kill more than "one bird with one stone," is expedient and convenient, both for writers and readers. Two very important subjects have lately been mooted in your pages—*Lightning Conductors* and *Wood Paving*. One gentleman recommends copper bands to be *attached* to the masts of a ship, and then to go down *through the keel* into the water! Is not this placing a very dangerous visitor in too close propinquity with the body to be protected? In my recent letter on lightning conductors—in which I say, that tubes, having two surfaces, are better conductors than solid rods—I forgot to mention, that the upper, or at least attracting part, should be perforated with holes. Gas tubes, tinned, would answer admirably. The chains I recommend to be carried down the shrouds, so as to touch the water. Conductors must be made fast to the walls of a building by stays of stone, or tile, or glass let into the wall; metallic staples are quite "*contraindicated*," as liable to induce *lateral* escapes of the electric fluid. Chain conductors should be filed, so as to present between each link a far greater contact of surfaces, than when they are left round, when they only touch each other by a point.

"*Junius Redivivus*" addressed you some short time ago on the subject of wood paving, and in his letter objected to the blocks being laid at an inclinaton of 45°. He is perfectly right in his theory. But in order to demonstrate the fallacy of a theorem, it is often necessary to push its confutation to the *argumentum ad absurdum*: so, for example, I will figure to you and your readers the *horizontal trunks of trees* laid down on many Russian and Polish roads, over which the carriages bump enough to shake the teeth out of the heads of travellers. Of course, great ruts are formed *across* these trees. So, taking this absurd position, we must come to the conclusion, that any angle deviating from *the vertical* must be more or less bad. The angle of 45° is just the medium between the worst and the best, which *is at no angle at all*, but *vertical*, as I recommended in my pamphlet of 1824, and still recommend; for which I was laughed to scorn by the periodicals, in prose and verse. "Junius Redivivus" must remember the song which appeared in the *Monthly Repository*, in reviewing the second edition of my pamphlet, published in 1834, which supposes a band of St. Giles's Irish labourers, "*warming their dusky hands at a Christmas fire, singing praises to Macerone, for supplying them with fuel from his wood pavement.*" It begins thus—

"London streets are paved with wood,
Long live Maceroni!
For we'll blow out with summut góod,
Sav'd out of our coal money," &c.

The *Monthly Repository* might just as well have represented these same people burning the doors and shutters of all the shops about their neighbourhood!!!

So it is with every introducer of any thing new. Fulton, Windsor, Koenig, &c., even to the immortal Watt, who worked his steam-engine patent *without profit*, until it was nearly expired; but, meeting with the rich Boulton, got from parliament another fourteen years' extension of the patent, and made a million of money!

To say a few words more on wood paving, I see in the newspapers that a brace of aldermen are exerting their voices in its depreciation. Now, Sir, *I*, who may justly be called the greatest promoter of it, so far back as 1824, may very easily be supposed to have paid some attention to its construction and use in the streets of this metropolis.

Although I have, over and over again, preached in your too good Magazine—too good for the rabble rich—how waste-

fully the wood and stone pavements are laid, with reference to materials, labour, and, most of all, *expense*, I think I may do some good, if people would "*read, mark, learn, and inwardly digest*," by repeating a truism, namely, that there is no need whatever for the substratum of gravel, then of broken granite, then of concrete. All this labour and expense could be saved, by the proper use of my patent machine, which you, Sir, christened (in 1824) "The Flying Stone-driver." With respect to the wood paving being more slippery to horses than the granite, I deny it *in toto*. I have watched carriages going over it, and then getting upon the granite; the slipping of the horses' feet was at least equal on both surfaces.

In my suggestion of wood paving of 1824, I propose to sift fine *dry* sand over it, so as to fill up all the interstices. Fine dry sand will form the firmest possible block between the blocks of wood or stones. I then advised hot coal-tar to be poured with a rose-spouted watering-pot over the wood pavement, which will have the effects of preservation and anti-slipriness. As to the present system of "grouting" upon the pavements after they are laid, it is utterly impossible to conceive any more evident exhibition of obstinate imbecility and waste! Every child knows that mortar, when dry, or "set," is extremely friable; to promote the pulverization of this "grouting," the lovely rammer called "Lady Griffin" is applied by dozens of grunting Irish paviors! Look at the wood paving along that street which goes diagonally from the Strand to St. Martin's, by the Charing-cross Hospital. Maugre all the substrata of gravel, granite, and concrete, it is as even as the surface of the Thames in a gale of wind! Every day, workmen are seen taking up blocks from out of holes—instead of adopting *my plan of beating down the* PROTUBERANCES *with my irresistible machine.*

I have some other matter to speak of, but time presses this week; so I must conclude by saying that I am

Your obedient

F. MACERONE.

February 14, 1843.

At Mr. Cunningham's, Publisher,
Adelaide-street, Trafalgar-square.

ALLOWANCES TO BE MADE IN THE CASE OF HIGH-PRESSURE STEAM-ENGINES FOR NOMINAL HORSE-POWER IN COMPARISON WITH LOW-PRESSURE ENGINES.

Sir,—There does not exist, I apprehend, any generally established rule for the horse-power of high-pressure steam-engines. In low pressure ones, custom seems to have authorised a sort of double standard, *first*, Boulton and Watt's rule for horse-power, or an approximation to it, for the commercial unit of size; *second*, a pressure of steam in the cylinder of about 16lbs. per square inch, as the basis of actual power, after the requisite deductions for friction and other resistances have been made—the steam being required to be supplied throughout the stroke from a boiler, having 2lbs. or 3lbs. per square inch on the safety-valve, and without any forced firing. With easy firing, these engines may be worked at half expansion, and the mean steam-pressure will then become about 14lbs. For commercial purposes the surplus steam-pressure transmitted to the crank is assumed as being about 7lbs. per square inch on the piston, and the cylinder is supposed to be of sufficient size, that when its area in square inches is multiplied by 7lbs., and again by about 220 feet per minute velocity, and the product divided by 33,000lbs., the result will represent the required number of units of nominal horse-power at which the engine is commonly rated. When, however, the values of the friction, and other resistances often included in that term, are deducted from the 16lbs. steam-pressure supplied to the cylinder by the boiler, the remainder, amounting to 10lbs. or 11lbs. multiplied by the area of the piston in square inches, and afterwards by its velocity per minute in feet, and divided by 33,000lbs., gives the number of units of actual horse-power. There is consequently a tendency to refer to the *nominal* horse-power, whenever it suits the interests of parties to underrate the power of an engine in comparison with the work done, and to refer to *actual* horse-power when the object is to overrate its power in comparison with the coal consumption per horse-power per hour.

The recent practice of increasing, in the river steam-boats, the pressure in the cylinder to 8lbs. or 10lbs. per square inch, and working it expansively, under circumstances that tend to increase,

rather than diminish, the actual pressure transmitted to the crank, presents similar difficulties, to a greater or less extent, to those which occur in estimates of the horse-power of high-pressure, or non-condensing engines.

An instance of conflicting statements of horse-power from the same data, may be noticed in the last January part of the *Mechanics' Magazine*, arising from the want of a standard for high-pressure engines, and well-defined forms of expression to represent the gross power exerted by the steam on the piston, and the surplus transmitted, or supposed to be transmitted, to the crank. The cylinders of the *Novelty's* engines are 13 inches diameter; length of stroke, 2 feet 4 inches, making 55 double strokes per minute; and the expression used is, that the "effective force of steam on the piston is about 20lbs. mean pressure, being cut off at half-stroke." This expression means, I apprehend, 20lbs + 14·7 = 34·7lbs mean cylinder total pressure, and consequently, $\frac{34\cdot7}{\cdot8465}$ = 41lbs. steam supplied from the boiler during half the stroke.

Tredgold, p. 188, (old edition,) uses the term "effective pressure" in a different sense, namely, as indicating the calculated pressure supposed to be transmitted to the crank for nominal horse-power, after numerous deductions are made from the boiler pressure as the basis of the estimate. Mr. Wimshurst, proceeding on the above data, in his Challenge to all England, calls the *Novelty's* engines, of about 25-horse-power. "Sternpost," in correction, estimates them at 41 horse-power, and omits any allowance over for engine friction. Now, 4·1 × 6 = 24½ horse-power, or about 25 horse-power. The question, therefore, that presents itself, is—whether this mode can be admitted as fair, in the comparison between high and low pressure engines, as regards nominal horse-power?

To obtain the assumed pressure in lbs. per square inch on the crank, we should have 2 lbs. × 6 = 12lbs. for comparison with 7lbs. out of 16lbs. The per centage of allowances and power would then stand thus:—

		lbs.	lbs.	Allowances	Power.
Low Pressure	Full Stroke........	16	7	56	44
	Half Expansion	14	7	50	50
High Pressure	Atmosphere Included	34·7	12	65	35
	Atmosphere Excluded	20	12	40	60

The necessary allowance for friction is greater in low than in high-pressure engines, on account of the air-pumps and injection-water, though, perhaps, not to the extent of 10 and 16 per cent., so that the above table justifies Mr. Wimshurst in adopting the simple rule of taking 60 per cent. of the gross pressure above the wasted atmosphere, for the pressure on the crank for nominal horse-power.

The practice of deducting the wasted atmosphere seems analogous to that of deducting the amount of the imperfect vacuum in low pressure engines, instead of treating both as items of the resistances to the total moving steam-pressure; yet in all cases I should consider the pressure shown by the indicator as the best basis for calculations, either of nominal or actual horse-power, especially for the comparison of engines of different classes. The more common method, however, is less objectionable when different engines of the same class are compared. In such cases, custom affords a strong plea for its continuance, but its liability to error and mistake, ought, perhaps, to induce a change to the more correct method, which affords better means of comparing the power directly with the water and coal consumption, necessarily used to produce the steam power.

The difference between actual and nominal horse-power has been often pointed out, but I would refer your readers to Mr. Bergin's "Observations on the Government Report on the Atmospheric Railway," as the best and simplest I have met with; and I trust the conduct

of the Commissioners will have the good effect of inducing the public to understand the general bearings of this subject.*

By a confusion in the calculations of the horse-power, the engine at Wormwood Scrubs was called a 25-horse-power engine, leading to the inference that its cost at about 40*l.* per horse-power would be about 1000*l.*, while it turned out that its commercial horse-power was only about 16, and the cost 640*l.*

All purchasers of high-pressure engines, who have a due regard to their own interest, should take care to purchase by a nominal horse-power, deduced from the actual power transmitted to the crank by means of a divisor of about 50,000lbs., instead of 33,000lbs., since no standard has or can be fixed for the pressure in non-condensing, or even expansion engines, like the commercial 7lbs. in Watt's engines. The relative price of 40*l.* on the nominal, is about 26*l.* 10*s.* on the actual horse-power. Probably some high-pressure engines, judged by these methods, may be found to be dear bargains.

I remain yours, &c., S.

" * James Watt originally estimated the unit of horse power as equivalent to 33,000 lbs. raised one foot high each minute: and on this estimate he established the dimensions and proportions of the several parts of an engine; so that, notwithstanding the various losses and expenditures of force, which he considered the steam to sustain between the boiler and the working point, there should still remain this amount of *available* power or *useful effect.* And from comparison of the dimensions of his engines with the above assumed effect, it would appear he considered that about four-tenths of the *original* power of the steam was thus absorbed: and this is the proportion of loss assumed, in the method for determining the horse-power of steam engines used by the reporters, which is the same as that generally given by writers on the subject. The steam-engine indicator, (an instrument which, though early proposed, I believe, by Watt himself, has only recently come into general use,) has incontrovertibly proved that the *useful effect* had been very much under estimated. Besides, since Watt's time the steam-engine has received, and is still receiving, most important improvements: the result is, as every person practically familiar with the subject perfectly well knows, that the quantity of water evaporated to produce the *useful effect,* which Watt estimated at 33,000 lbs. raised one foot each minute, does in fact produce at the working point an effect more nearly represented by 55 to 60,000lbs. raised the same space in the same time; or, making ample deduction for the condenser and feed-pumps, friction, &c. and, in the present case, for the friction of the exhausting pump, there remains, as already quoted from the report, an available power of 52,000 lbs. or upwards.

" Engine makers have not thought it expedient to change the horse-power dimensions of their engines, such having by use become the *commercial* standard for price; but they know very well, and so does the purchaser know (or he ought to know) that by (say) a fifty horse engine, is meant one which, by using the ordinary formula of calculation, will give the power named; but which, by the consumption of a given quantity of fuel, raises for each such horse-power not 33,000 lbs. but 55,000 to 60,000 lbs. the work of the pumps, friction, &c. included; such being the actual work performed by modern well constructed steam-engines."—*Mr. Bergin's Pamphlet*, p. 16.

SCIENTIFIC NECROLOGY FOR 1842.

[From Minutes of the Proceedings of the Institution of Civil Engineers.]

Mr. Samuel Seaward, F.R.S., &c., was born at Lambeth in the year 1800, and at the age of fourteen years he entered the service of the East India Company as a midshipman; after his second voyage to Bombay and China he relinquished a naval career, and was placed by his brother as an apprentice with the late Mr. Henry Maudslay, in whose establishment he had the best opportunities of acquiring a practical knowledge of mechanics and engineering; of these opportunities he carefully availed himself, and always cherished a grateful recollection of his instructor. After passing about five years with Mr. Maudslay, he entered the service of Messrs. Taylor and Martineau, whence he proceeded to Cornwall, and assisted, under the direction of Mr. Arthur Woolf, in the erection of several large pumping engines; he then undertook the superintendence of part of the works of Mr. Harvey, at the Hayle Foundry, where he had the advantage of the instructions of Mr. Richard Trevethick.

In the year 1825 he returned from Cornwall and joined his brother, Mr. John Seaward, in the Canal Iron-works, Limehouse, as manufacturers of marine and other steam-engines, as well as of general machinery.

The attention devoted by Mr. Seaward to the construction of marine engines particularly, and the successful adaptation of the "direct action" engines (which were, it is believed, first introduced by Mr. Gutzmer, of Leith, on board the *Tourist* steamer,) are well known in the profession.

His ingenuity and mechanical talents are manifested in all the works undertaken by the firm to which he belonged, and by several scientific pamphlets which he published.

He joined the Institution in the year 1828, and became subsequently an active and useful Member of Council, and our Transactions are indebted to him for a memoir "On the application of Auxiliary Steam Power to Sailing Vessels on Long Voyages."

Snatched from among us at the early age of forty-two years, the profession has lost an intelligent and zealous member, and

his private friends a worthy and estimable man.

Mr. Benjamin Hick was born at Leeds in the year 1790, and was brought up as a practical engineer in the establishment of Messrs. Fenton and Murray, by whom, at an early age, he was intrusted with the superintendence and erection of several large engines, &c., and he was eventually offered a partnership in their works; this he declined, and in 1810 engaged with Mr. Rothwell in the Union Foundry at Bolton, of which he was the managing partner; and in 1833 he established the Soho Foundry, now carried on by his sons in that town.

His attention was directed to almost all branches of mechanics, and the ingenuity displayed in his inventions and improvements is generally acknowledged: some of his improvements have become public property without being claimed by him, or its being known from what source they emanated.

He became a member of the Institution in the year 1824, and although the distance of his residence precluded his frequent attendance at the meetings, he was a liberal contributor to the collection of models, &c.

His good taste, his integrity of character, the encouragement which he extended to talent of all kinds, and the assistance given by him to all public improvements, obtained for him considerable influence in the town of Bolton, where his loss will be much felt.

Mr. Charles Collinge was born in the year 1792, and being engaged from an early age in mechanical pursuits, he eagerly embraced the proposition of your Vice-President, Mr. Henry Robinson Palmer, to unite with him and a few more young men in forming a society for mutual improvement, by discussing scientific subjects; from this commencement, in the year 1818, has arisen the Institution of Civil Engineers, which now numbers five hundred and twenty-five members of all classes.

Mr. Collinge continued, through all the stages of its progress, an useful and active member; he took his share of the duties as a Member of the Council, and filled the other offices of the Institution with readiness, and his attendance at the meetings was very constant.

Mr. W. D. Anderson was a pupil of our first President, Mr. Telford, after whose decease he travelled to Italy, whence he sent to the Institution a series of drawings of the Ponte Santa Trinita at Florence. On his return he was engaged under Mr. W. Anderson, (his father,) the engineer of the Grand Junction Water-works, on several surveys and other works. He then gave plans for, and was appointed engineer to, the Exeter Water-works, which situation he resigned in 1837, in order to become engineer to the corporation of Newcastle-on-Tyne, where he constructed some important works. Ill health obliged him to resign this latter appointment in the year 1841, and his decease took place during the last summer.—*Report of the Council.*

From the Address of the President.

Having referred to the subject of our Steam Fleet, I may mention that, until the year 1835, there was no Chief Engineer and Inspector of Machinery for the Navy, and that *Mr. Peter Ewart*, who died during the last summer, first held that office. As he was not a Member of the Institution he is not noticed in the Report of the Council; but the situation he held, and his talents, will, I trust, be considered sufficient to make acceptable a short notice of some facts respecting him.

Mr. Ewart was born on the 14th of May, 1767, at Troquaire Manse, in the county of Dumfries. His father, and two or three generations before him, were clergymen of the Church of Scotland. Peter was the youngest of a family of ten children, (six sons and four daughters.) The father's care was divided between the duties of his parish, his private studies, and the early education of his family, which he superintended,—the result proves how successfully; two of his sons having been well known as among the most eminent merchants in Liverpool, and a third as envoy of this country at the court of Berlin, where he died at the early age of thirty-two years. At nine years of age Peter was sent to the Dumfries parish day-school, where he had the benefit of good masters, particularly of Dr. Dinwiddie, an excellent mathematical teacher. At this period his natural turn for mechanics showed itself. His hours of recreation were spent in the shop of a watch and clock maker, (named Crocket,) which lay between the school and his home; and so well did he profit by what he saw there, that at the age of twelve he had, from materials which he had collected, made and finished a clock that performed well, and was the most interesting piece of furniture in his bed-room. In his fifteenth year he went to Edinburgh, and attended a course of lectures, probably those of Professors Robison and Playfair, as these distinguished philosophers were subsequently on the most intimate terms with Ewart.

John Rennie, the late eminent engineer, had a short time before this begun business as a millwright in East Lothian, and on Ewart's leaving Edinburgh he was sent to Rennie. Ewart told me that he was Rennie's first apprentice; that Rennie had but one journeyman; and that one of the first jobs

of the trio was the construction of a small water-mill (the Knows Mill) upon Fantassie farm, for which a shed was lent by Rennie's elder brother George, who aferwards stood as high as an agriculturist as his brother John did as an engineer. He described to me the scene that took place on the day this mill was started, when, inspired by the success of his first work, his master foretold, to the astonishment of his journeyman and apprentice, his own future greatness.

The facts that the celebrated James Watt was about this time employed in the erection of his steam-engine to work the Albion Mills, which stood at the south-east angle of Blackfriars-bridge, now Albion-place, that he applied to Professor Robison to recommend to him an intelligent well-educated mechanic to superintend the mill-work, and that Robison fortunately recommended Rennie, the Lothian millwright, who had distinguished himself in his class, are well known. And here I would call the attention of my young friends to the illustration which Robison's recommendation, as well as Rennie's success, affords, that a practical knowledge of millwrighting is one of the best, if not the very best, foundation for engineering.

Soon after Rennie's arrival in London, he sent for his apprentice Ewart to assist him in the erection of the Mills,—a proof of his opinion and his friendship. Ewart followed his master. How well he had calculated the expense of the journey may be collected from the fact that the last penny he had was paid as toll for passing Blackfriars-bridge to enable him to reach the mill. For four years, 1784 to 1788, Ewart worked as a millwright at these mills, whence he was sent by Mr. Rennie to Soho, to construct a water-wheel for Mr. Boulton's rolling-mill, and was afterwards taken into the service of Boulton, Watt, and Co., to erect their steam-engines. There he had ample scope for his abilities, and the advantage of Watt as his friend; this friendship terminated only with Watt's life, and was continued by the present Mr. Watt, whom I have often heard speak with the greatest respect of Ewart's abilities and excellent qualities.

In 1791 he was sent by Boulton and Watt to fix one of their engines upon the cloth-works of Benjamin Gott and Co., Leeds. Mr. Gott, who was then a young man, and became afterwards one of the most public-spirited and liberal, as well as greatest manufacturers in this country, was just the person to appreciate Ewart's qualities; the engine superintendent became his friend, and that friendship remained firm and unchanged for nearly half a century. I have heard Mr. Gott speak in the highest terms of Ewart. The following anecdote, told me by Mr. Gott, proves that others, well able to judge, entertained the same opinion. A gentleman speaking of Ewart at Mr. Gott's table, said he had met with but few better practical mechanics than Ewart; "You have been a fortunate man," said Professor Playfair, who was of the party, "for I have never met with one."

In 1795 and 1796 he assisted the present Mr. Watt in planning the buildings and works of the Soho foundry, shortly after which he quitted engineering as a profession, and became a manufacturer, first at Stockport with Mr. Oldknow, then shortly after in Manchester with Mr. Gregg, and afterwards he took a cotton-mill on his own account. His bias being always so much towards mechanics, it is not improbable that his idea was that he could make great improvements in the cotton machinery, and that this led him to engage in the business of a manufacturer.

Ewart remained in Manchester in constant association with Dr. Dalton, Dr. Henry, Mr. Kennedy, and other eminent men, until 1835, when he was recommended by the present Mr. Watt to the Admiralty, as a proper person to fill the situation which he held until the time of his decease, on the 15th of September, 1842, then in his seventy-sixth year. His health had been delicate for some time, but the immediate cause of his death was a blow from the end of a chain, which broke when he was standing near it in the Dock-yard at Woolwich. Notwithstanding the long interval between his quitting the practice of engineering, and his returning to it, and notwithstanding his age (sixty-eight years) when he undertook the office, he gave, so far as I have ever heard at the Admiralty or elsewhere, great satisfaction. The professional responsibility, in his own department, of the steam machinery of the British Navy rested upon him, and how well he acquitted himself is proved by the results in China and Syria, and in almost every other quarter of the globe.

Mr. Ewart's change of employment for so long a period of his life has caused his name and character to be less generally known than they deserved to be. Like Playfair, I may say that I never met with a man who had so general an acquaintance w[illegible] engineers and mechanical men of his own time as Ewart had, but he was not easily brought out. I have often pressed him to record, in some way, his great store of anecdotes and interesting facts, but my doing so was in vain. To write, or even to speak on matters in which he had taken an active part appeared painful to him, and was never done

when with more than one or two friends. His knowledge of machines, and particularly of the principles of the steam-engine, was very intimate. His admiration of Watt, and his practice at Soho, inclined him to view with some degree of scepticism any innovation in the engine, which he considered to have been almost perfected by his great master; and, for the public situation which he held, this prejudice was probably useful, for the war steamers in active service are not those in which new schemes should first be tried.

Ewart was a warm and persevering friend to merit. My friend, Mr. Hartley, Engineer to the Liverpool Docks, considers that he owes his appointment chiefly to Ewart's exertions in his behalf, and Ewart was ever afterwards ready to assist Mr. Hartley with his scientific opinion. Mr. Hartley is conscious of the advantage he derived from it, and considers that by Ewart's death he has lost his best and ablest friend and counsellor. Sir Edward Parry, (the Comptroller of Steam Machinery to the Navy,) in a note I have lately received from him, states that, "after more than five years' constant and intimate acquaintance with Mr. Ewart, he must declare that he never met with a man of sounder judgment, more amiable feelings, or stricter integrity of purpose; and that he felt he had, at his decease, lost an esteemed friend, as well as a valuable coadjutor in the public service." Sir Edward's note then refers to the late results of the war in Syria, and still later in China, in which he says, "the mighty power of steam played so decisive a part, that these wars, humanly speaking, may be said to have been entirely terminated by steam."

I will close this subject with an extract of a letter, dated in 1793, from Dr. Currie, of Liverpool, (the elegant biographer and editor of Burns,) to Mr. Wilberforce. The letter is given in the first volume of Wilberforce's correspondence. It appears, by the description, that at that time the distress of the cotton manufacturers was greater than even any thing of recent date; that the workmen were in a starving state; and that Ewart, the partner of Oldknow, went to Liverpool to represent the extreme case, and endeavour to obtain the attention of ministers through the members. He had a meeting with Dr. Currie, who writes thus to Wilberforce, in order to increase his attention to the statement of the case.

"(Ewart) is no common character: he was with Boulton and Watt, as superintendent of machinery, and has an extraordinary degree of the most useful knowledge of every kind; and, in a word, is one of the first young men I ever knew. These qualities recommended him to the notice of the manufacturers, among whom he exercised his profession of mechanic and engineer. He had offers of partnership from the first houses there, and was actually taken into the house of Mr. Oldknow, (of Stockport,) at that time the first establishment in Lancashire. Mr. Oldknow was the original fabricator of muslin in this country, and a man of first-rate character."

THE "LESSON ON PUDDING BOILING."

Sir,—The pudding boiling philosophy of T. B. Lanadives, (No. 1014, p. 30,*) is of such an extraordinary nature, as to warrant a belief that his gallantry has led him to overstep the bounds of prudence, by placing on record his want of knowledge of some very simple facts. Of course, it is well known to your readers that water boils at 212°, in an open vessel, the action of the atmosphere preventing the temperature from rising any higher; and in vacuo the boiling point is much lower.† It is a fact equally well known to your readers, that under increased pressure the temperature is higher. T. B. L. says, when the pot-lid is closed, the heat soon drives out the air, and a more or less perfect vacuum is formed! This may be Mr. L.'s philosophy, but it does not agree with that of my grandmother, who says she closes the pot-lid that it may boil the sooner, and lifts it, if it boils too fast. I cannot make the old lady comprehend what a vacuum is; but she has no doubt, if it once got into the pot, it would spoil the best pudding that ever was made. According to T. B. L., the heat drives out the air; so it does, but only by increasing the pressure of the internal steam. Nothing akin to a vacuum, either more or less perfect, takes place.

Yours respectfully,
JOHN VALENTINE.

Derby, February 14, 1843.

THE "PRINCE ALBERT" STEAMER—THE "MAGICIAN" OUTDONE!

A new iron boat, of this name, made an experimental trip, on Wednesday, the 15th

* We think it but fair to ourselves to state that the article commented on was inserted by mistake. It came to our hands more than a year ago, (as the writer can bear us witness,) and was rejected at the time, as founded on an obvious error; but having, through some oversight, found its way into our portfolio of "accepted" papers, it was transferred thence to the printer, to fill up a spare corner, by an assistant, who thought it no part of his duty to scan its merits.—Ed. M. M.

† T. B. L. says 172° Fahr.—no doubt an error of the pen or press for 72°.—Ed. M. M.

instant, from Blackwall. The boat and engines have both been built from the designs of a Swedish engineer, of the name of Cahlson; the former at Newcastle, and the latter at the factory of Messrs. Milner, and Co., of the New-road. The following are the dimensions of the boat:—

	feet
Length	155
Breadth of beam	19
Draft of water	$3\frac{1}{2}$
Diameter of paddle-wheels .	$17\frac{1}{2}$
Breadth of ditto	9

The engines are on the direct action principle, but on an entirely new plan, of which we shall give a full account in an early Number. We give, in the mean time, the following dimensions:—

The engines are two 50's.	= 100 h. p.
Diameter of cylinders . . .	40 inches.
Length of stroke	40 ,,
Total breadth from cylinder flange to flange.	10 feet.

The boilers are tubular, on the plan of Mr. Spiller.

The vessel started from the Brunswick Pier, Blackwall, at 25 minutes past 11, nearly low water, and arrived off Shell Haven, a distance of 33 miles, in two hours and five minutes, the engines making from 31 to 33 revolutions a minute. Off Shell Haven she met the *City of Canterbury* coming up, and, giving her a start of three or four minutes, turned round at precisely half-past 1, passed the *Canterbury* before reaching Gravesend, and arrived off the Brunswick Pier at twenty-one minutes past 3, which is calculated to be at the rate of *seventeen miles and a quarter per hour*, or a quarter of a mile more than the speed achieved by the *Magician*. (See *Mech. Mag.*, No. 1012, p. 603.)

DR. ATKIN'S EXPERIMENTS AT THE ADELAIDE GALLERY ON THE TRANSMISSION OF CALORIFIC RAYS.

Eagle's Crags. O'Connell Mountains, County Clare—February, 1843.

"Obediendo leges naturæ, naturam vincere possumus."—*Lord Bacon.*

My dear Friend,—Since my last communication to you, I have seen in the *Mechanics' Magazine*, a letter signed "An Amateur," in which the writer very ungenerously accuses Doctor Atkin of trickery in his experiments at the Royal Adelaide Gallery with the Cambridge focus. He roundly gives the reader to understand that the Doctor has recourse to a kind of legerdemain in producing his effect on the thermometer, and in the combustion of the phosphorus.

Dr. Atkin has himself indignantly repelled this imputation in his lectures, and I consider myself bound, in common justice, to give my public testimony and refutation.

As I am the person who first, in experiment by an optical combination, created this burning focus; and as I have had repeated opportunities of witnessing and scrutinizing Doctor Atkin's experiments, I may be fairly supposed to be good authority on this subject.

Now I am bound to declare, in addition to what I have before recently published in your own pages in eulogy of their infinite beauty, that I have never yet, in all my experience, seen experiments conducted with more philosophical fairness, or with more philosophical absence of all flourish or ostentation.

Since I have the pen in my hand, I may as well send you, for the *Mechanics' Magazine*, the following quite new theorem in submarine science, which, perhaps, may not be entirely without interest to your readers; I will send you a drawing and a demonstration for a future publication.

Theorem.

It has been proved experimentally at Navarino, (see *Mechanics' Magazine*, Oct. 1839,) that the human frame can endure, and that man can work under the pressure of condensed air, which will prevent the water from entering the diving-helmet at a depth under the sea of 25 fathoms.

Let it be assumed that this is the greatest depth that, in the present state of physiological and engineering science, can be endured in the diving-helmet, or common diving-bell, without the destruction of human life.—Now I can demonstrate in the abstract, (assuming strength of materials, and power of pneumatic machinery,) that by the principle of construction of my bell, a power is created for the diver of descending several fathoms deeper, and of illuminating and viewing objects, for example, on the bottom, or even of lighting a fire upon the bottom, if so disposed. Believe me to be, my dear Friend, whether engaged in Irish Agitation, or working under the sea, with the truest esteem,

Ever most sincerely yours,

THOMAS STEELE.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

DAVID NAPIER, OF MILL-WALL, ENGINEER, *for improvements in steam-engines and steam-boilers.* Patent dated August 9, 1842; Specification enrolled February 9, 1843.

The improvements in "Steam-Engines" are three in number.

The *first* consists in having four piston rods passing through stuffing-boxes in the steam cylinder cover, and attached to a cross-head which is joined to the crank by means of a connecting rod working downwards, so that the main shaft has two piston rods on each side. The crank is situated immediately over the cylinder cover, and works quite close down upon it.

The *second* and *third* improvements are nearly similar to the first, only that in the one case there are two piston-rods, and in the other but one.

The improvements in "Steam-Boilers" will be understood from the following sketches: — The fire is applied below at

Fig. 1.

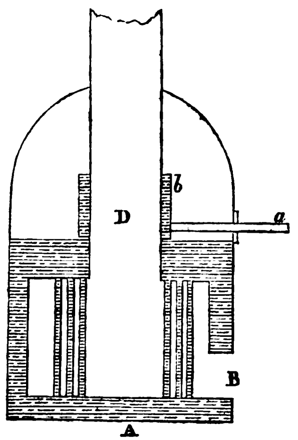
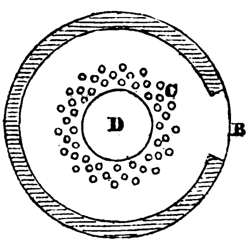


Fig. 2.



A, fig. 1; the heated air goes through the flue B, circulates among the pipes C, and passes up through the funnel D. Fig. 2 is a cross section through the pipes, &c. The water for feeding the boiler enters by the pipe *a*, rises up through the heater *b*, which surrounds the funnel, on that part within the boiler which is occupied by the steam, and then flows over the top into the boiler.

Richard Ford Sturge, of Birmingham, Manufacturer, *for a certain improvement in the manufacture of Britannia metal and plated wares.* Patent dated August 10, 1842; Specification enrolled February 10, 1843.

Mr. Ford's improvement relates to such goods made of Britannia metal and similar alloys as have their surfaces prepared by "buffing," "burnishing" or "polishing." By means of dies and rollers of various patterns, and also by the application of various tools while revolving in a lathe, &c., these articles are to have their surfaces *wholly* covered over, either with what is termed, "frosted," "grassed," "matted," or "dead surface" work, which is to be cleaned by brushing with soap and water, or by "dipping" in acids dissolved in water. The patentee does not claim the application of "grassing," "matting," &c., which has been heretofore partially applied to the surfaces of such goods, but claims its application to *the whole* surface.

NEW PUBLICATIONS ON THE ARTS AND SCIENCES IN FEBRUARY, 1843.

Original and Improved Builders' Price-book. Corrected by C. Cresy, Esq., according to the New Tariff.

Principles of Mathematical Geography, comprehending a Theoretical and Practical Explanation of the Construction of Maps; with Rules for the formation of the various kinds of Map Projections. By W. Hughes, F.R.G.S.

Memoirs of the Royal Astronomical Society, vol. xiv., containing the Results of Experiments made with the Torsion Rod, for determining the Mean Density of the Earth.

Report on the Geology of the County of Londonderry, and parts of Tyrone and Fermanagh. By J. E. Portlock, F.R.S. (Government Series.)

Year-book of Facts in Science and Art; exhibiting the most important discoveries and improvements of the past year.

Periodicals and Serials.

Philosophical Magazine, No. 143, Third Series.

Edinburgh New Philosophical Journal.

Civil Engineer and Architect's Journal, No. 65.

Architect, Engineer, and Surveyor, No. 37.

Annals of Chemistry and Practical Pharmacy, No. 15.

The Chemist, No. 2. (New Series.)

The Pharmaceutical Journal and Transactions. By Jacob Bell. No. xx.

The London Journal, (Newton's,) No. 134.

The Repertory of Patent Inventions, No. 2. (Enlarged Series.)

The Record of Patent Inventions, No. 5.

The Practical Mechanic, (Glasgow,) Part 18.

The Artizan. A Monthly Journal of the Operative Arts. No. 1.

A new journal, of good promise, devoted to the same subjects as our own. "Dr. Lardner and Atlantic Steam Voyaging" is an able review of the progress of Atlantic steaming during the last eight years; but ending in the very questionable conclusion, that, because it has hitherto been attended with loss, it must ever continue to be so—all the many plans for economizing fuel and steam notwithstanding. "The College for Civil Engineers" is another good article, though on a rather hopeless subject. "Our Club, No. 1"—so out of place, that we hope it will be No. 1 and last.

The Builder, Nos. 1 and 2.

Another new journal, which is "exclusively devoted to the interests of Builders," including "all classes connected with the Building business, from the Labourer to the Architect." But little original strength is put forth in these Numbers; neither does the plan of the journal appear to be as yet more than half developed; but, so far as we can judge from the imperfect specimens before us, the editor has very correct views of the important service which such a literary organ is capable of rendering to the numerous classes to which it is addressed, and is well qualified to carry them out. We observe in No. 2 the announcement, for the first time, of two new collegiate institutions. One is an Architectural College, which is stated to have been "founded in London on Advent-eve, 1842," and which, if it is as successful in improving our architecture as in devising ridiculous offices, and coining hard names for the holders of them, will effect wonders. Among the dignitaries are a "Professor of Concreting and Opus Incertum," a Baptisterographer, an Itinerant Delineator, a Mensurator, a Custos, a Cataloguist, three Chaplains, and an Embroidress! The other is a "Builders' College," of which Mr. Hansom, the architect of that beautiful building, the Birmingham Town-hall, is to have the entire direction, and from which, though humbler in its pretensions, we anticipate a great deal more good. Mr. Hansom states, that his study has been to "lay down a plan for the instruction of architectural decorators and furnishers, which shall combine the advantages of the school, the office, and the workshop; so that general education, professional training, and handicraft skill, may be acquired and perfected together—that the benefits of college discipline and residence, of systematic tuition under different masters, of lectures and examinations, and of constant familiarity with books, models, and works, may be united in one establishment."

Edinburgh Review, No. 155. Article 7—On "the Lost Standards of Weights and Measures—Principles of Metrical Reform."

United Service Magazine, (Colburn's,) No. 170.—A Third Notice of "Naval Improvements of the Nineteenth Century" is devoted to "Steam Navigation," and contains some valuable information, derived, apparently, from official sources, respecting the dimensions, armament, &c., of government steamers.

Westminster Review, No. 76. Art. 10—"Drainage."

The Penny Cyclopædia, Part CXX. *Tubercularini—Typhaceæ.*

Among the articles in this Part there is a very good one on Turning; including an account, with engravings, of the Rose Engine, which we do not remember to have seen described before, in any English work.

Illustrated Polytechnic Review.

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 28TH OF JANUARY, AND THE 23RD OF FEBRUARY, 1843.

William Weild, of Manchester, engineer, for certain improvements applicable to window-blinds and curtains, parts of which improvements are also applicable to doors. January 28; six months.

John Barrow, of East-street, Manchester-square, engineer and smith, for certain improvements in the manufacture and hanging of window-sashes. January 28; six months.

David Isaac Wertheimer, of West-street, Finsbury-circus, gent., for improvements in calculating machines, part of which improvements is applicable to purposes where wheel-work is required. (Being a communication.) January 28; six months.

George Benjamin Thorneycroft, of Wolverhampton, ironmaster, for improvements in furnaces used for the manufacture of iron, and also in the mode of manufacturing iron. January 31; six months.

William Mangham, of Newport-street, Lambeth, chemist, for an improvement in preparing aerated water. January 31; six months.

William Barnard Boddy, of Saint Mary, Newington, surgeon, for improvements in apparatus and means for opening, shutting, and fastening every description of sliding and lifting window sashes, windows, and window shutters. January 31; six months.

William Robinson Shaw, of Leeds, engineer, for certain improvements in feeding or supplying steam boilers with water. January 31; six months.

Samuel Kirk, of Staly-bridge, Lancaster, cotton-spinner, for certain improvements in machinery or apparatus, for preparing cotton and other fibrous substances for spinning. January 31; six months.

Charles Hancock, of Grosvenor-place, artist, for an improved means of dyeing or staining cotton, woollen, silk, and other fabrics, and rendering them repellent of waters and moisture. January 31; six months.

Charles Clark, of Great Winchester-street, London, merchant, for an improved pyro-hydro pneumatic apparatus, or means of generating, purifying, and condensing steam and other vapours, and of extracting from vegetable substances, the soluble portions thereof, as also the application of parts of the said apparatus to other heating, evaporating and distilling purposes. January 31; six months.

James Clark, of Glasgow, power-loom cloth manufacturer, for an improved mode of manufacturing certain descriptions of cloths. February 1; six months.

John Hill, of Manchester, machine-maker, for certain improvements in or applicable to looms for weaving carpets and various other fabrics in which raised loops or a raised pile constitute the face or the figure of the fabric. February 11; six months.

Robert Hicks, of Old Burlington-street, surgeon, for certain improvements in apparatus for impregnating liquids with gases. February 11; six months.

Joseph Morgan, of Manchester, manufacturer of patent candle-making machines, for improvements in the manufacture of candles. February 11; six months.

Jonathan Badger, of Sheffield, carpenter and builder, for improvements in the construction of bedsteads for invalids. February 11; six months.

Christopher Nickels, of York-road, Lambeth, gentleman, for improvements in the manufacture of fabrics made by lace machinery. February 11; six months.

Thomas Ensor, of Milborne Port, glove-manufacturer, for improvements in the manufacture of leather gloves. February 11; six months.

Henry Du Bochet, of South Wall, Ireland, piano-forte tuner, for a new method of making piano-fortes. February 11; six months.

Thomas Wolferstan, of Salisbury, Ironfounder, for certain improvements in axletrees and axletree boxes. February 11; six months.

Alfred Brewer, of Surrey-place, Old Kent-road, wireweaver, and felt-manufacturer, for improvements in machinery for manufacturing paper. (Being a communication.) Febr. 11; six months.

George Ebenezer Doudney and Edward Phillips Doudney, of Mile-end, Portsea, candle-manufacturers, for improvements in the manufacture of dip and mould candles. February 17; six months.

James Boydell, Junr., of Oak Farm Iron Works, nearly Dudley, ironmaster, for improvements in apparatus for retaining the wheels of carriages in the event of an axis breaking or otherwise. February 17; six months.

Henry Ross, of Leicester, worsted manufacturer, for improvements in combing and drawing wool, and other fibrous substances. February 17; six months.

Charles Brook, of Meltham-mills, York, cotton-spinner, for certain improvements in the apparatus used for purifying gas. February 17; six months.

William Newton, of Chancery-lane, civil- en-

gineer, for an improved system of working coal-mines and quarries of stone, marble, and slate, which may also be applied to the making of Tunnel borings, or to other purposes of the like kind. (Being a communication.) February 20; six months.

John Kymer, of Pontardalaw, South Wales, coal proprietor, and Thomas Hodgson Leighton, of Llanelly, Carmarthen, chemist, for improvements applicable to the burning anthracite or stone coal, and other fuel, for the purpose of obtaining heat. February 21; six months.

Joseph Crannis and Robert Kemp, both of Southwark, furriers, for certain improvements in wood-paving. February 21; six months.

Benjamin Brunton Blackwell, of Newcastle upon Tyne, gentleman, and William Norris, of the City of Exeter, civil engineer, for an improvement in coating iron, nails, screws, nuts, bolts, and other articles made of iron with certain other metals. February 21; six months.

Lawrence Holker Potts, of Greenwich, doctor of medicine, for a new or improved method or methods of conveying goods, passengers, or intelligence. February 21; six months.

Henry Clarke, of Drogheda, linen-merchant, for improvements in machinery for lapping and folding all descriptions of woven textures and surface fabrics. February 23; six months.

Francis Roubiliac Conder, of Highgate, Middlesex, engineer, for improvements in the cutting and shaping of wood, and in the machinery for that purpose. (Being a communication.) February 23; six months.

LIST OF PATENTS GRANTED IN IRELAND BETWEEN OCTOBER 19, AND DECEMBER 30, 1842.

Joseph Whitworth, of Manchester, Lancaster, engineer, for certain improvements in machinery or apparatus for cleaning roads, and which machinery is also applicable to other similar purposes. Sealed November 1; six months.

Claude Edward Deutsche, of Fricour's Hotel, Saint Martin's Lane, Middlesex, gentleman, for improvements in combining materials to be used for cementing purposes, and for the preventing the passage of fluids, and also for forming articles from such composition of materials. (Being a communication.) November 7.

John Cox, Gorgie Mills, near Edinburgh, tanner and glue manufacturer, for improvements in the processes of tanning and leather dressing. Nov. 18.

James Pilbrow, of Tottenham Green, Middlesex, engineer, for certain improvements in the application of steam, air, and other vapours, and gaseous agents, to the production of motive power, and in the machinery by which the same is effected. November 18.

John Mitchell, of Birmingham, Warwick, steel-pen manufacturer, for a certain improvement in the manufacture of metallic pens, and a certain improvement in the manufacture of pen-holders. December 5.

John Spinks, the younger, of John-street, Bedford-row, Middlesex, gentleman, for an improved apparatus for giving elasticity to certain parts of railway and other carriages requiring the same. (Being a communication.) December 5.

Matthew Gregson, of Toxteth Park, Liverpool, Lancashire, esquire, for an improvement applicable to the sawing or cutting of veneers. (Being a communication.) December 10.

John Ridsdale, of Leeds, York, esquire, for improvements in preparing fibrous materials for weaving and sizing warps. December 24.

John Bishop, of Poland-street, Middlesex, jeweller, for improvements in apparatus used for retarding carriages on railways, parts of which are applicable for portioning power; and improvements in steam cocks or plugs. December 24.

John Thomas Betts, of Smithfield-bars, London, gentleman, for improvements in covering and stopping the necks of bottles, jars, vases, and pots. (Being a communication.) December 24.

Isham Baggs, of Wharton-street, Middlesex, chemist, for an improvement or improvements in the production of light. December 29.

Samuel Carson, of York-street, Covent-garden, Middlesex, gentleman, for improvements in purifying and preserving animal substances. Dec. 29.

William Coley Jones, of Vauxhall-walk, Lambeth, Surrey, for improvements in treating or operating upon a certain unctuous substance in order to obtain products therefrom for the manufacture of candles and other purposes. December 29.

George Edmund Donisthorpe, of Bradford, York, top manufacturer, for improvements in combing and drawing wool and certain descriptions of hair. December 30.

Charles Maurice Elizee Sautter, of Austin-friars, London, gentleman, for improvements in the manufacture of sulphuric acid. (Being a communication.) December 30.

James Morris, of Cateaton-street, London, merchant, for improvements in locomotive and other steam engines. (Being a communication.) December 30.

William Coley Jones, of Vauxhall-terrace, Surrey, practical chemist, and George Fergusson Wilson, of Vauxhall, in the same county, gentleman, for improvements in operating upon certain organic bodies or substances, in order to obtain products or materials therefrom for the manufacture of candles and other purposes. December 30.

NOTES AND NOTICES.

Iron Dwelling-House.—A large iron mansion has been built by Mr. W. Laycock, of Old Hall-street, in this town, the inventor of a new principle in the application of iron to building purposes. The fabric, which has been made in separate plates, is now erecting for the purpose of public exhibition, previous to its transmission to Africa, where it will be used as a palace by one of the native kings. This singular building has three floors, exclusive of an attic. The basement story is seven feet high; the second, 10 feet; and the third, in which is the grand suite of state apartments, is 12 feet high. In these his sable majesty will give his state audiences. The principal reception room, the presence chamber, is 50 feet by 30, and ornamented throughout in a style of most gorgeous magnificence. To counteract any annoyance from heat, the inventor has contrived the means of admitting a current of air, which can be regulated at pleasure, to pass through an aperture left between the outer plate and the inner panel.—*Liverpool Albion.*

Another Steam Leviathan.—We learn from the New York papers that the largest steam-boat in the world, was expected to be shortly launched from the ship-yard of Wm. H. Brown. She is built for the Troy Company, and will run on the Hudson river between Troy and New York. She is *three hundred and thirty feet in length*, and her breadth of beam exclusive of guards, is thirty feet six inches. Her burthen will be about one thousand tons, and it is supposed she will prove the fastest boat ever built.—*Montreal Herald.*

LONDON: Edited, Printed and Published by J. C. Robertson, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by W. and A. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1021.] SATURDAY, MARCH 4, 1843. [Price 3*d*.

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street.

MR. GOLDSWORTHY GURNEY'S IMPROVEMENTS IN THE BUDE LIGHT.

Fig. 1.

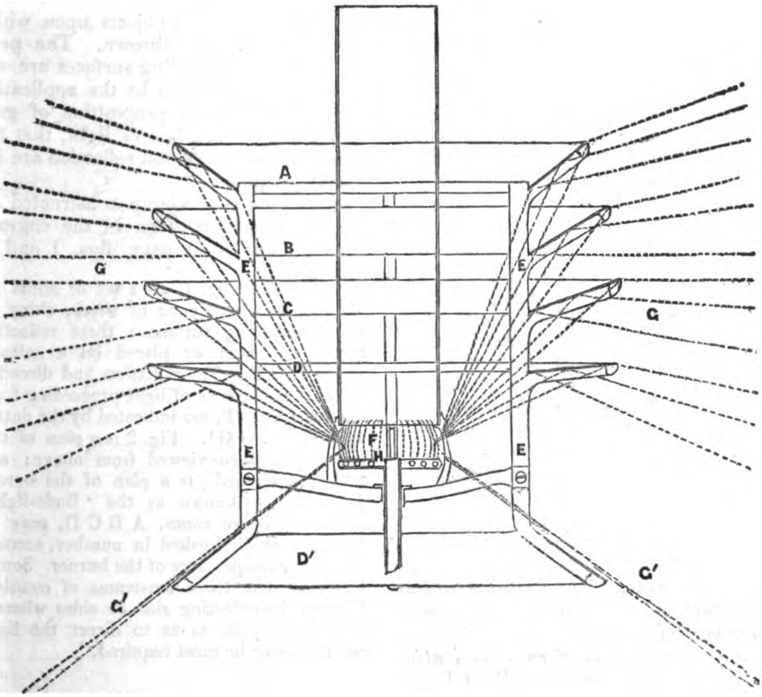
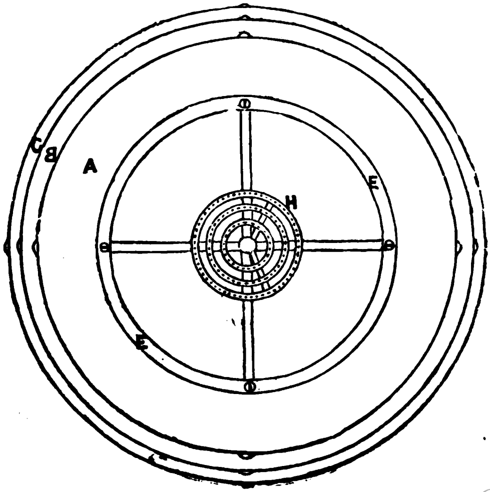


Fig. 2.



MR. GOLDSWORTHY GURNEY'S IMPROVEMENTS IN THE BUDE LIGHT.

[Patent dated August 18, 1842; Specification enrolled February 18, 1843.]

Mr. Gurney, the author of the well-known "Bude Light"—the subject of one of the most flagrant, and, to our great surprise, still unrestrained piracies of the day—has patented some further novelties in lighting, which, it is to be hoped, are destined to share a better fate. However difficult it may be to extract from the specifications of Mr. Gurney's former patents sufficient subject-matter to substantiate a claim of original invention—on which point our opinion is already before our readers, (see No. 998)—it is not to be denied that the light to which Mr. Gurney gave the name of the "Bude," was *such a light* as had never been produced before. And undoubtedly there is great force in what Dr. Ure says in his Report, (published at length in No. 1000,) as to the *legal* right of the author of such a new and beneficial result to the protection of a patent,—"By the evidence (before the House of Commons Committee) it is clearly proved that artificial light is thus produced in greater quantities, and of a better quality, than by any other means heretofore known, and at a saving of 50 per cent. A material benefit is, consequently, conferred upon the public, and such as is intended to be protected by the statute, *even if the patentee laid no claim to the novelty of any of the apparatus or materials used.*" Still less can there be any question, *in foro conscientiæ*, that to pass off this identical Bude Light, under the name of another person, as something entirely different, is a most gross and impudent piece of imposture.

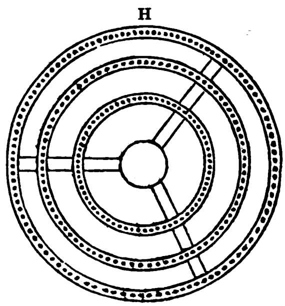
Mr. Gurney's present improvements consist in "certain arrangements," whereby he is enabled, "*first*, to disperse the light produced, and apply it more advantageously for the purposes of illumination; *secondly*, to produce the light with greater steadiness and uniformity, by regulating and equalizing the supply of gas from the mains, or first supply; *thirdly*, to carry off the heat which attends the production of light, and to economize that heat, by applying it to useful purposes."

1. The arrangements for dispersing and applying the light consist in disposing curved or plane zones or facets, with reflecting surfaces around the light, in such a manner, as to direct the light in certain directions, and to render as much of the light as possible profitably useful or available for purposes of illumination. These zones, facets, or reflecting surfaces, are to be placed at particular angles, which will depend on the relative situation of the light and of the objects upon which the light is to be thrown. The positions of these reflecting surfaces are determined, in all cases, by the application of the well-known proposition of geometry and of the law of light, that the angles of incidence and reflection are invariably equal.

An example of a lamp constructed on these principles is given in the engravings on our front page, figs. 1 and 2.

"A B C D, fig. 1, are a set of zonal reflectors, which may be of silver, china, or other reflecting surfaces: these reflecting zones are fixed or placed on a suitable frame E E E. The radiation and direction of some of the rays of light proceeding from the focal light F, are indicated by the dotted lines G G[1], G G[1]. Fig. 2 is a plan of this apparatus, when viewed from above; and fig. 3, (subjoined,) is a plan of the burner K, which is known as the 'Bude-light' burner. These zones, A B C D, may be increased or diminished in number, according to the temperature of the burner. Sometimes I make them frustrums of conoidal figures, the reflecting side or sides whereof may be curved, so as to direct the light where it may be most required."

Fig. 3.

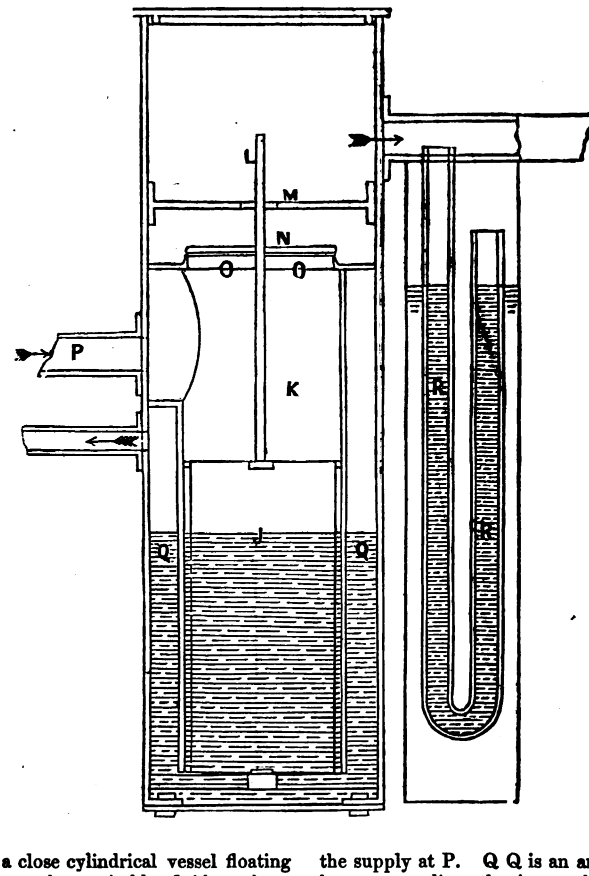


2. The arrangements for producing greater steadiness and uniformity in the light consist in the addition of a gover-

nor or apparatus, depending for its action on the principle of the equal transmission or equality of pressure in all directions by fluids, whereby the pressure at which the gas is to be supplied to the burner having been determined and adjusted, the same pressure or supply at the burner will be preserved, notwithstanding the variations which ordinarily occur in the mains or sources from which the gas is supplied.

The subjoined figure is a section of this governor, and the description which follows is from Mr. Gurney's specification:

Fig. 4.

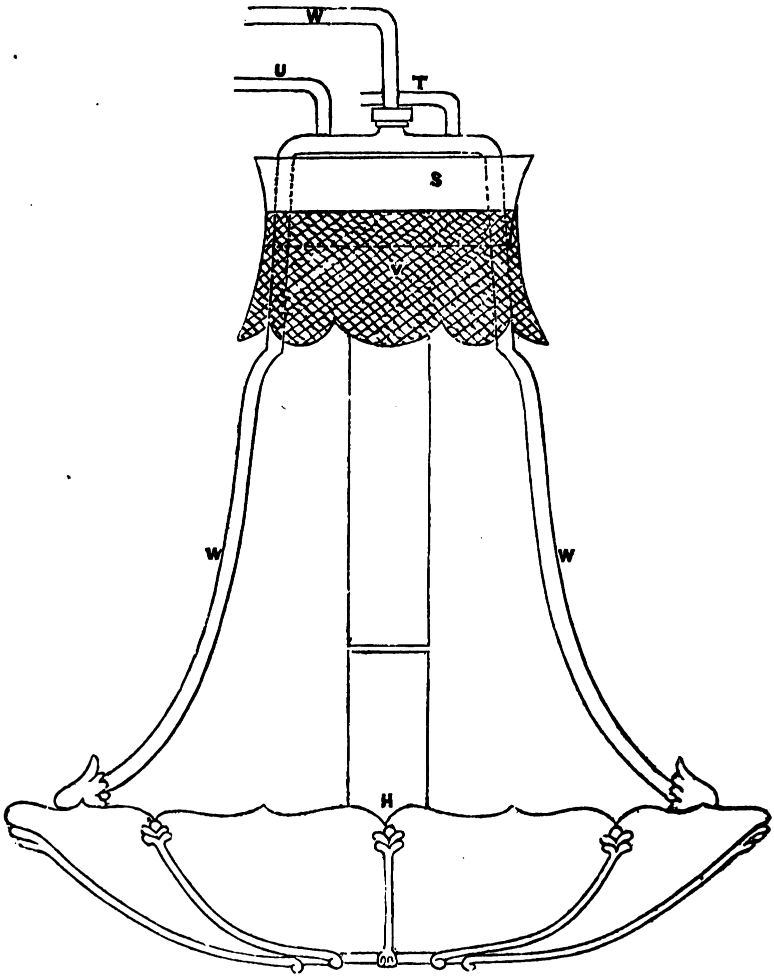


"J J is a close cylindrical vessel floating in water, or other suitable fluid, and so formed that it can rise or fall in the chamber K K K, as the quantity of water in this chamber is increased or diminished. By the rod L, which plays through the bridge M, the disk valve N is firmly attached to the float J. The area of this valve at its seat, and the cross sectional area of the float, should be the same. The disk-valve N rests upon the edge of the valve-seat O O, when the fluid has been sufficiently depressed in the chamber K, by the gas flowing in from the supply at P. Q Q is an annular chamber surrounding the inner chamber K K, and when the pressure of gas is equal on both of the surfaces of the liquid in K and in Q the valve N stands a little open. Now, suppose the gas to be passing in a steady manner through the inlet P, and the open valve and the outlet to the burners, (the quantity being regulated in the usual manner, by a main or service cock;) and suppose that, by the action of the wind, or the turning off of numerous other lights, a sudden rush of gas comes upon the surface of

the liquid in K, it will be depressed, and that in Q Q will be raised, so that the valve N will be depressed, and the opening reduced. It must be observed that the valve N is not intended at any time to form a perfectly tight joint, otherwise the lights would be extinguished by its sudden and perfect closing. R is a common syphon gauge, for observing the relative pressure of the gas on one limb, and of the atmosphere on the other."

3. The chief arrangement for carrying off the heat consists in placing above the

Fig. 5.



burner a vessel containing water, and in using, in connexion with this vessel, a metallic fabric, such as wire gauze, whereby the heat which is generated in the production of the light may be absorbed by contact with, and by the conduction of, the metal, and so carried away. "The vessel placed immediately above the lamp communicates, by an upper and an under pipe, with another vessel, in any convenient situation, either within or without the building. The steam, vapour, or heated water, by virtue of the change in its specific gravity from heat, will pass along the upper of these pipes, and be replaced by cold water

through the lower or under pipe, by the circulation of the water in these pipes, or in any similar system of pipes and vessels, either closed, or open to and communicating with the atmosphere, according to the principles and arrangements which are well understood by persons who have been in the habit of employing steam and water circulating in pipes and vessels for the purpose of warming." The heat of the lamp may thus be removed, and the apartments lighted by gas prevented from becoming unpleasantly heated; and the heat so transferred may be applied for various useful purposes, as the heating of water required for domestic and other purposes, and for warming other parts of the building.

"Fig. 5 exhibits a pendant light fitted with a heat-absorber. S is a vessel containing water; T is a water supply pipe, from any suitable tank or chamber; U is a pipe for carrying off the vapour formed by the action of the heat from a flame at H: this heated vapour or steam may, by means of the pipe *v*, be conveyed to heat baths or rooms; V is a wire gauze fabric for absorbing other portions of the heat; W is the gas-pipe."

Mr. Gurney describes another sort of water absorber, which may be employed "when it is not proposed to appropriate the heat for other purposes." The steam which collects at the top of the vessel containing the water is conveyed down through a pipe placed immediately over the burner, on coming into close vicinity to which it becomes so rarefied, as to diffuse itself throughout the apartment where the lamp is hung, in the state of a moist, and therefore salutary, but imperceptible vapour.

Mr. Gurney describes also a pendant burner where there is no water absorber employed, but merely a pipe to carry off the heat to any part of a building where it may be required.

THE "MAGICIAN" AND "PRINCE ALBERT" STEAMERS.

Sir,—Taking much interest in the success of iron as a ship-building material, I was pleased by reading in your last Number, (1020,) a statement of the trial of the new iron steamer, *Prince Albert;* but, as the statement referred to is not exactly correct, I am desirous of rendering it so, fearing that any exaggeration will do harm to the cause of iron ship-building.

The statement runs thus:—"The vessel started from the Brunswick Pier, Blackwall, at 25 minutes past 11, nearly low water, and arrived off Shell Haven, a distance of 33 miles, in two hours and five minutes." Now, Sir, I find, from the best authority, (Captain Bullock's map of the river Thames, at the Admiralty,) that the distance from Brunswick Pier to Shell Haven is only 28½ miles. The *Prince Albert's* performance, therefore, in this run, was but 13·6 miles per hour, instead of 17¾ miles per hour. The distance down and up averaged 14·4 miles per hour, which will be found nearly equal to any thing that has yet been done.

Allow me to make, also, one observation on the "details of experiments" with the *Magician*, in your 1012th Number. It is there said—"At about half-past 11, she stopped for a few minutes at Gravesend, and then proceeded, with a strong breeze ahead, and adverse tide, and at a quarter past 1 o'clock passed the Nore Light." Now, this distance, I find, from the same authority, is 24·75 miles, which was done at the rate of 14·1 miles per hour. This is certainly tremendous going when we consider that it was against wind and tide; for it must not be lost sight of, that the *Prince Albert* had the tide in her favour more than half the time of her trial.

However, they are both good proofs of the efficiency of iron as a ship-building material.

I am, Sir, respectfully yours,

L. P.

February 27, 1828.

HOW TO RENOVATE WORN-OUT FILES AND RASPS.

Sir,—Allow me to lay before your readers a plan, often practised by me, for restoring, in a great measure, the sharpness of files and rasps, that have become abraded and filled up through use.

Boil the file in a very strong solution of soda, or, what is still better, soap-boilers' lees, which removes all the adherent dirt. It must then be allowed to remain for about half a minute in a solution composed of two parts of water and one part of nitric or muriatic acid; and after that, washed with water, and slightly brushed over with oil of turpentine.

To show the efficiency of the dilute acid in producing a keen edge on blunt instruments, dip therein a round pointed needle, or worn knife, and the result will be satisfactorily seen. I am, Sir, &c.,

Z. ROCKLINE.

Newcastle-upon-Tyne, Feb. 13, 1843.

LONDON FIRES IN 1842.

With some Notes on the Great Fire at Hamburgh.

Most useful is the might of Fire,
    When man controls and guides its course;
And whatsoe'er his thoughts desire
    He fashions by its helping force.
But fierce its might and dread its force,
    When from control and guidance free
It rushes headlong from that course,
    In all its native anarchy.
Woe! when loose from all its ties,
    And to its growing rage no bar,
Swift the conflagration flies,
    Like an elemental war,
On each hand, above, around,
Is death and desolation found!—*Translation from Schiller.*

Sir,—It was quaintly observed by Honest Master Stowe, upwards of two hundred years ago, that "the only plagues of London are immoderate quaffing among the foolish sort, and often casualties by fire."

Notwithstanding the exertions of Father Mathew and the spread of temperance principles—notwithstanding the numerous improvements in our domestic architecture, and the remarkable efficiency of our present provisions for dealing with that element which is so good a servant and so bad a master, these matters still form the principal—though the not only—"plagues" of "the world's metropolis."

Of the latter class of plagues—"*often casualties by fire,*" each succeeding year brings a steady increase, even beyond that which might be considered due to an increase of population and of buildings. During the year just ended there were no less than 769 fires, being an increase of 73 on those in 1841; and an excess of 213 above the average of the nine previous years during which the Metropolis has been under the protection of the London Fire Establishment.

The particulars of last year's fires are as follows:—

MONTHS.	Number of Fires.	Number of Fatal Fires.	Number of Lives Lost.	Alarms from Chimneys.	False Alarms.
January	65	3	3	5	1
February	55	3	6	4	9
March	64	1	1	13	6
April	57	1	1	13	2
May	64	0	0	5	5
June	71	1	1	5	5
July	73	0	0	4	5
August	78	0	0	3	9
September	51	0	0	5	6
October	68	2	2	8	4
November	68	0	0	8	7
December.....	55	2	9	9	2
Total......	769	13	23	82	61

Of these fires, the number wherein the premises were totally destroyed was....	24
Very seriously damaged	224
Slightly damaged..	521
	769
Alarms occasioned by fires in chimneys	82
False alarms..	61
Making the total number of calls during the year	91

The number of instances in which an insurance was known to have been effected.

On the building and contents	321
On the building only	116
On the contents only	112
Neither insured	220
	769

The following Table exhibits an epitome of the results of London fires for the last ten years; being the time that the London Fire Establishment has been in operation.

YEARS.	Number of Fires.	EFFECTS.			Number of Lives lost.	Alarms from Chimneys on fire.	False Alarms.
		Totally destroyed.	Seriously damaged.	Slightly damaged.			
1833	458	31	135	292	12	75	59
1834	482	28	116	338	7	106	63
1835	471	31	125	315	14	106	66
1836	564	33	134	397	14	126	66
1837	501	22	122	357	19	127	89
1838	568	33	152	383	21	107	80
1839	584	17	165	402	32	101	70
1840	681	26	204	451	31	98	84
1841	696	24	234	438	19	92	67
1842	769	24	224	521	23	82	61
Annual average	577,4	26,9	161,1	389,4	19,2	102,0	70,5

The number of alarms from chimneys on fire and false alarms, are considerably between the average; indeed, with one exception (1833), they are the smallest number yet reported. This number, however, is exclusive of a very large number of chimneys on fire known to be such, and attended by the firemen accordingly.

By a somewhat singular coincidence, the number of *total losses* is the same as in the previous years. With three exceptions, these fires were of a most insignificant description. In seven instances the premises consumed were mere sheds; in five cases they were carpenters' workshops, built wholly of timber, and of small dimensions; in seven cases the buildings were small dwelling-houses, situated at considerable distances from the nearest engine station, and completely on fire when the first discovery was made. One house fell down before the fire had attained any head, and one was blown down by an explosion of fireworks.

Happily, I have not to record, during the past year, the destruction by fire of any public edifice or building of importance; on the contrary, the general feature of last year's fires, was, with a few exceptions, of the most trifling and insignificant character. The following fires are deserving of particular notice from the peculiarity of circumstances by which they were each distinguished. Numerous other fires might be enumerated, did space permit, which presented difficulties of no ordinary kind, and the suppression of which in their earlier stages, reflects the highest credit, both on the excellent arrangements of the London Fire Establishment, and the indefatigable perseverance, intrepidity, and skill of those upon whom it devolves to carry out and give practical efficiency to these arrangements:—

Jan. 14, 9 P.M. Grange Paper Mills, Blue Anchor-road, Bermondsey. This fire, which was supposed to be wilfully occasioned, broke out soon after the workmen had left work, and burned with great rapidity. The firemen and engines were as prompt in their arrival as the distance would permit, *but upwards of three quarters of an hour elapsed before the Southwark Company's mains yielded a drop of water*. By this time the machine-room was entirely destroyed, and the rest of the premises in imminent danger; by great exertions, however, the engine-house and bleaching-house were preserved. The property was covered by an insurance

in the British Fire Office, but the claim was resisted by the insurers, against whom an action was brought, and the case was tried at Guildford in August last, when the insurance office obtained a verdict.

Jan. 18, 1¼ A.M. Mr. Marley, Bee-hive, Harrow-road. Mr. Marley and his family retired to rest about half-past twelve o'clock. In about an hour afterwards, he was alarmed by the unusual barking of his dog, and on going down stairs, found a back room in flames. Having opened the street-door to give an alarm, the flames rushed across the bar, and prevented his return. All the inmates escaped over the roof, except James Morris, the pot-boy, (17 years of age,) who was too sound asleep to be roused. One of Wivell's fire-escapes was soon on the spot, but the conductor had not courage enough to ascend, or to make the slightest effort toward rescuing the unfortunate lad. After all attempts to induce the man to ascend had proved vain, Mr. Marley himself went up, but it was then too late, as the flames had taken possession of the room. The engines from the western Stations were soon on the spot, and in effectual operation, but the building and its contents were nearly destroyed before the fire could be got under.

February 15, 1¼ A.M. Mr. Payten, private dwellling-house, 5, Kent-terrace, Old Kent-road. This fire, which originated from some unknown cause, completely destroyed the building and contents, before a drop of water could be obtained for the numerous engines, which arrived in rapid succession.

February 19, 4¾ P.M. Messrs. Rennies' Foundry, Holland-street, Blackfriars-road. A number of workmen were employed in casting a large diving-bell, when the cauldron, containing six tons of fluid metal, was upset. Several of the workmen were seriously hurt, and one of them (James Barry) died of the injuries he received. The premises were set on fire, and several brigade engines, as well as the floating engine from Southwark-bridge, were promptly in attendance, but their services were not required, Messrs. Rennies' men having subdued the fire with their own fire-engine.

February 28, 11¾ A.M. Mr. D'Ernst, Doughty-street, Lambeth-walk, firework-maker. At the time stated, the inhabitants of Lambeth were alarmed by a tremendous explosion, which was found to have taken place at Mr. D'Ernst's premises, and had blown down his workshops, and set fire to the dwelling house. The West of England and brigade engines were soon brought up, and fortunately a supply of water (a rare thing in this locality) enabled them to be got into active operation, and the fire was soon extinguished. On entering the ruins, the lifeless bodies of Mr. D'Ernst, John Whiting, and George Tubbett, (two of his workmen,) and Ann Hampshire, (sister in law of Mr. D'Ernst,) were found, shockingly mutilated.

March 1, 11 P.M. Mr. Davidson, printer by steam power, 6, Tudor-street, White-friars. The first intimation of this fire was the bursting of a great body of flame from the first-floor windows; on the alarm being raised, the firemen and engines from the Farringdon-street station were in immediate attendance, but *for upwards of twenty minutes no water was to be had*, the New River turncock having, by some mistake, been called to Chancery-lane. As soon as this unfortunate error was rectified, and water procured, a number of engines, which had by this time arrived, were brought to bear upon the fire, which had completely destroyed Mr. Davidson's premises, and seriously damaged several of those adjoining.

March 8, 6½ P.M. Mr. Marks, auctioneer, 5, Albion-place, Battle-bridge. One of the main-pipes of the Imperial Gas Company having been damaged, as was supposed, by some workmen who were making a sewer, an escape of gas had taken place into the cellar of Mr. Marks' house. The female servant (Jane Atwood, aged 22) having occasion to go into the cellar with a lighted candle, had no sooner opened the cellar-door than a tremendous explosion took place, and the unfortunate female became enveloped in flames, by which she was so dreadfully burned that she expired soon after in the hospital.

March 18, 9¾ P.M. Messrs. Wilson and Co., hatmakers, Holland-street, Blackfriars-road. This fire had attained a considerable head before it was discovered. On the arrival of the West of England and brigade engines, the plugs of the Lambeth and Vauxhall Companies were both opened, *but no water was forthcoming for upwards of half-an-hour after the arrival of the engines.* A supply of water was at length obtained from the Lambeth pipes, and the fire speedily extinguished, but above two-thirds of Messrs. Wilson's extensive works had by this time been destroyed.

March 26, 11 A.M. Mr. Everett, cooper, Ferry-road, Millwall. These premises consisted of an extensive range of workshops, and two very small dwellings, principally of timber, all which, in a few minutes, became enveloped in flames. Several private and dock engines were soon on the spot, *but no water could be had to render them available.* The brigade engines from town were prompt in their arrival, and by means of a chain of engines, the water in a distant ditch was made available for quenching the fallen ruins.

May 16, 2½ A.M. Mr. Firth, surgeon, 11, Suffolk-place, Lower-road, Islington. This fire is said to have been the work of an incendiary; the building appears to have been fired at the back on nearly every floor, as the flames burst forth at once from the second and third floor windows with great vehemence, and in less than five minutes broke through the roof. The Islington engine (a very good one) was brought up in good style, and speedily set to work with the best effect. Not more than fifteen minutes had elapsed between the discovery of the fire, and the engine being in full play upon it, but by that time the whole of the building, from the first-floor upwards, had been consumed. The front parlour, kitchens, &c., on the basement story, with the shop behind, to which the fire had not previously communicated, were preserved. A fire which had been kindled under the stairs in the basement story, was fortunately extinguished before it had communicated with the fires above.

June 30, 3 A.M. Mr. Ramsey, plumber, glazier, &c., 13, Bermondsey-wall. This fire, the most destructive on the Surrey side of the river since the fire at Fenning's Wharf, broke out in the paint-shops of Mr. Ramsey from some unknown cause, (probably spontaneous combustion,) and was no sooner discovered by the policeman on duty, than it communicated with the premises of Messrs. Cotten and Co., coopers and general dealers, and assumed a fearful aspect. Several private engines were got out, but no one present understood putting them into operation, and if they had, they would still have been useless from want of water. The floating engine from Rotherhithe was brought up alongside, and got into action, and a strong muster of land engines were soon in attendance. The floating engine was also brought down from Southwark-bridge as soon as possible. In the mean time, the flames had seized upon the granaries of Mr. Landell, and had also communicated to a number of dwelling-houses around, as well as to two immense piles of hoops belonging to Messrs. Cotton and Co., the flames from which drove back the firemen to a considerable distance. As no water could be obtained to supply the land engines, it was thought better to make an effort to preserve the valuable and extensive water-side warehouses, by means of the floating engines, in preference to risking their destruction by attempting to rescue the smaller buildings at a distance from the water side. The two powerful floating engines, which, for a long time, were the sole dependance of the firemen did extraordinary execution, each being equipped with two branch-pipes, and but for their presence the entire range of wharfs in Bermondsey Wall would have been destroyed. At a later period, water was obtained on the land-side, and the fire was soon afterwards stopped. Eight buildings were entirely destroyed, and thirteen others seriously damaged. Upwards of five hundred persons (firemen and auxiliaries) were actively engaged in the suppression of this fire.

September 15, 1½, P.M. Messrs. Taylor and Richards, wadding manufacturers, James-street, Kennington Common. These premises were discovered to be on fire (for the third time within two years) soon after the workmen had left for dinner; and the carding-room with its valuable contents was entirely destroyed. The speedy arrival of the West of England and Brigade engines, however, preserved the other part of the premises.

November 4, 3½ P.M. Mr. Ramsay, wholesale druggist, 154, Upper Thames-street. A workman employed in packing a quantity of sulphuric ether, unfortunately knocked two of the bottles together and broke them, when their highly inflammable contents took fire from a candle with which he was working; the other bottles being broken by the heat, the whole of the premises were instantly filled with flames, and the inmates obliged to make a precipitate retreat. The Watling-street and other engines were soon at the scene of danger and in full operation; the floating engine from Southwark bridge was also brought alongside the shore and set to work. Notwithstanding the powerful efforts made to extinguish the fire, from the combustible contents of the warehouse, it raged for some time with great violence and communicated to the adjoining buildings, and was not subdued until Mr. Ramsay's premises had been entirely destroyed and three adjoining buildings very seriously damaged.

November 18, 10¾ P.M. Mr. Smith, private dwelling-house, 36, Paradise-street, Rotherhithe. This fire burst forth so rapidly that the inmates narrowly escaped with their lives; one young woman precipitated herself from a front window and was seriously hurt. The engines from Rotherhithe, Tooley-street and other stations soon arrived, but no water could be obtained for half an hour, by which time the building and contents had been consumed.

December 14, 10 P.M. Mr. Shackleton, greengrocer, 17, Little Prescott-street, Goodman's-fields. This was by far the most distressing fire of the year from the melancholy loss of life by which it was attended. The house was let out in lodgings, occupied by no less than seven different

families. The first floor front room, in which the fire commenced, was occupied by Mr. Younker, an importer and vender of Dutch drops. The fire seems to have been occasioned by a spark from the fire falling on a dog's back, which caused him to seek shelter in some straw behind a bed in one corner of the room. On the flames bursting forth, the inmates made no effort to suppress them, but seemed wholly intent in making good their own escape. An alarm being raised from the street, two young females, Julia and Nancy Holland, threw themselves out of a second floor window; the latter in some measure broke her fall by striking the lead flat over the shop, but was taken to the hospital dreadfully injured. Her sister was killed on the spot. The engines from the Brigade station in Wellclose square were on the spot in a few minutes, closely followed by others, all of which were quickly in operation, and the fire was very soon got under. After the fire was extinguished information was given to the firemen that several persons were missing, upon which the scaling ladders were raised and the several floors searched, when the bodies of seven more unfortunate sufferers were discovered in various parts of the building. Most of the neighbours and police who were present at the outbreak of the fire appear to have been completely paralyzed by fear, and to have lost all presence of mind. Had a sheet, carpet, or even a policeman's coat, been held up for the reception of Julia and Nancy Holland, it is pretty certain that they might have been caught uninjured. And that the building might have been entered and more of the inmates rescued, was proved on the inquest by Mr. Proudfoot (father of two of the deceased,) who said "I was returning home when the alarm of fire was given. I ran towards my house. There were a great many policemen there. I called to them, 'Will you come and aid me to save my children?' They did not assist me. I had to assist myself. *I rushed through the flames twice* and took four of my children who were huddled together—the baby I threw down stairs like a dog. I saved only two of them. *I returned once more* to my room, which was then filled with smoke, and was nearly suffocated. I could do no more, and retired." If this poor man could *enter his room three times* at this comparatively late period (after a number of policemen had arrived,) it is evident that prior to that time all the inmates ought to have been rescued! A serjeant and two police constables stated on the inquest, that every man of the police present did *all he could* to render assistance on the occasion. It is a great pity that this useful body of men, who in general are destitute of neither zeal nor activity, are not *by proper instruction and training*, qualified and prepared to render *more effectual assistance* upon such emergencies.

The following list exhibits the occupancy of the various premises in which the fires have originated, discriminating as heretofore, between those which began in that portion of the building appertaining to the trade of the occupant, from those which happened in, and damaged the dwelling-house only:—

Apothecaries	5
Bacon dryers	2
Bagnios	7
Bakers (bread and biscuit)	16
Barge and boat builders	2
Basket makers	1
Beer shops	5
Blacking makers	2
Booksellers, binders and stationers	11
Brewers	3
Brokers and dealers in old clothes	6
Builders	2
Butchers	1
Cabinet makers	6
Caoutchouc manufacturers	1
Card makers	1
Carpenters and workers in wood	35
Chandlers	6
Cheesemongers	3
Chemists, manufacturing	5
Churches	1
Coach makers	3
Cochineal dryers	1
Coffee roasters	6
Coffee shops and chop-houses	4
Colour makers	4
Confectioners and pastry cooks	4
Coopers	2
Cornchandlers	4
Curriers and leather dressers	1
Distillers	5
Ditto illicit	2
Docks	2
Drapers, woollen and linen	18
Druggists, wholesale	1
Drysalters	1
Dyers	3
Eating houses	3
Farming stock	8
Feather merchants	1
Firework makers	3
Floor-cloth manufacturers	2
Founders	7
French fancy warehouses	2
Furriers and skin dyers	2
Gas works	6
Grocers	5
Hatters	7
Hemp and flax dressers	3
Hotels and club houses	10
Japanners	1
Lamp-black makers	1
Laundresses	1
Leather (patent) manufacturers	2
Lodgings	53
Lucifer match makers	7
Marine stores, dealers in	2
Naphtha manufacturers	1
Nuts, dealers in	2
Oil and colourmen (not colour makers)	11
Painters, plumbers and glaziers	4
Paper mills	1
Paper stainers	2
Pawnbrokers	2
Printers, letter press	5
Printers, copper-plate	1
Prisons	2

Private dwelling-houses	269
Public buildings	2
Public places of amusement	1
Rag merchants	2
Ribbon dressers	1
Rope makers	1
Sack makers	1
Sail makers	1
Sale shops and offices (no hazardous goods)	29
Saw mills (steam)	3
Ship builders	1
Spice merchants	1
Stables	16
Starch makers	1
Steam ships	1
Straw bonnet makers	2
Sugar refiners	1
Tailors	5
Tallow melters, soap boilers and wax chandler	4
Tanners	4
Tinmen, braziers and smiths	7
Tobacconists	3
Varnish makers	1
Victuallers, licensed	39
Vinegar makers	1
Under repair and building	5
Unoccupied	5
Upholsterers	1
Wadding makers	3
Warehouses	10
Weavers (willow)	2
Wharfs	1
Wine and spirit merchants	3
Wood merchants	1
Workhouses	2
Total	769

The number of fires on each day of the week was as follows:—

Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Sunday.
111	132	112	95	108	106	105

The hourly distribution throughout the day and night has been as follows:—

	First Hour.	Second Hour.	Third Hour.	Fourth Hour.	Fifth Hour.	Sixth Hour.	Seventh Hour.	Eighth Hour.	Ninth Hour.	Tenth Hour.	Eleventh Hour.	Twelfth Hour.
A.M.	42	47	31	23	18	20	9	15	17	19	20	19
P.M.	31	27	21	20	26	27	51	59	60	71	57	39

The causes of fire, so far as they could be ascertained, were as follows:

Accidents of various kinds, for the most part unavoidable	24
Apparel, ignited on the person	9
Bleaching with sulphur	3
Candles, various accidents from	67
——, setting fire to bed-curtains	64
—— —— window-curtains	58
Carelessness, palpable instances of	19
Cats, fires caused by	6
Children playing with lighted candles	3
—— with fire	6
—— with lucifer matches	6
—— with gunpowder	1
Cinders put away hot	3
Coffee and chiccory roasting	5
Coppers set against partitions	4
Fire heat, various applications of, to hazardous manufactures	16
Fires, sparks from	23
—— kindled on hearths, and in other improper places	9
Fireworks, making of	2
Fireworks, letting off	5
Flues, defective	21
——, foul and ignited	39
——, overheated	21
——, stopped up	9
Friction of machinery	4
Fumigation, incautious	2
Furnaces, overheated, &c.	23
Gas, accidents from the escape of	36
——, carelessness in lighting of	10
——, left burning	6
Gunpowder, explosions of	3
Hearth, defective	3
Illumination	1
Intoxication	11
Lamps, Naphtha	2
Lightning	4
Lime, slacking of	4
Linen, airing of	41
Lucifer matches, making of	8
——, using	9
Ovens, defective, overheated, &c.	13

Pitch, boiling of	6
Poker left in fire	1
Reading in bed	2
Shavings, loose, ignited	22
Spontaneous ignition of coals	3
——— cotton waste	1
——— dung	1
——— hay	4
——— lamp-black	4
——— leather waste	2
——— rags	3
——— tan	2
Stills (2 illicit)	4
Stoves, defective, overheated, &c.	15
——, drying	12
——, gas	1
Suspicious	9
Tobacco-smoking	17
Varnish and naphtha making	6
Wilful (buildings, 15; farms, 4)	19
	737
Unknown	32
Total	769

Although the metropolis has, during the past year, escaped comparatively unscathed by the awful ravages of the "bright destruction," several of our provincial towns, as well as many towns and cities on the Continent, have suffered most severely;* Crediton, Liverpool, Manchester, and some others, have been remarkable for the awful character of the visitations they have experienced. Many of the continental fires have also been of the most serious description. All other fires, however, sink into comparative insignificance when compared with the fire at Hamburgh, which broke out at 1 o'clock on the morning of Thursday, the 5th of May, and raged unceasingly till noon on the following Sunday. For some time it was supposed that the engines would subdue the fire: the Hamburghers being extremely conceited as to the excellence of their engines, and their admirable system of insurance and fire prevention. By 10 o'clock, however, the fire had extended so much, that it was quite evident it had gone quite beyond the control of any ordinary means of extinction. Blasting was speedily suggested, but the authorities were reluctant to give their consent to such a desperate remedy. Attempts were made to pull down some houses in the direction the fire was taking, but without avail. Artillery was next employed, and partial blasting at length resorted to, but with no better success. After much time had thus been lost, a sufficient quantity of gunpowder was obtained, and an extensive and well-arranged plan of blasting was executed, under the direction of Messrs. Lindley, Giles, and Thompson, English engineers, by which the fire was, for the first time, checked, and ultimately stopped, preserving the new town from destruction. At an early period of the fire, organized bands of cruel, heartless wretches went about with axes, breaking open and plundering houses, many of the *firemen* joining them, and becoming "furniture savers" on their own account, to a great extent—nothing, apparently, being too hot or too heavy for them. Much valuable property was subsequently recovered from the houses of these fellows, on being searched by the police. On Sunday the fire drew to an end, amid a storm of wind and rain, and a still more fearful disorganization of all the social elements. Colonel Hodges, the representative of our Queen, asserted "that, in the long experience of his professional career, amidst the horrors of warfare and the pillage of captured cities, he had never witnessed a spectacle of such misery and distress."

A most inveterate antipathy, on the part of the lower classes of Hamburgh, towards foreigners in general, and the English in particular, led to the most lamentable results; they were every where attacked, many were severely injured, and some killed. Messrs. Giles, Lindley, and Thompson—but for whose exertions the whole of Hamburgh would unquestionably have been destroyed—were maltreated, and narrowly escaped with their lives. This was a sad return for the exertions of our active, skilful, and energetic countrymen, who for sixty hours had laboured incessantly, without an interval of rest. To show the almost incredible extremities to which the bad passions and prejudices of the deluded Hamburghers carried them, I may mention, that although Mr. Smith, an Eng-

* No town throughout the provinces has suffered so greatly from fire as Crediton; since its total destruction, in the years 1742 and 1796, most extensive fires have occurred almost annually, and the losses to the West of England, and other fire-offices, have been very heavy. The visitation in July last destroyed nearly forty houses.

lishman, and proprietor of some water-works in Hamburgh, begged of the firemen to use the water from his mains, they actually persisted in fetching it in carts from a distance of nearly a mile, and going without any between the arrival of supplies, in preference to using the "English water!!!"

From official returns I find that this dreadful fire destroyed—

102 stores and warehouses;
1749 houses;
1508 flats, or separate floors, occupied by the poorer classes;
488 small cottages, similarly inhabited;
477 cellars, let separately, and having no connexion with the houses, inhabited by the working classes and small tradesmen: making altogether
4219 dwellings, by the destruction of which, 5,160 families, (20,000 individuals,) became houseless.

Upwards of 40,000*l.* was subscribed in England, alone, for the relief of the unfortunate sufferers: the total amount of subscriptions, from England and other countries, being nearly 269,000*l.**

A writer in the *Westminster Review* justly observes, that "they are much mistaken, who suppose that the construction of all English towns is so much superior to that of Hamburgh, that, at a moment's notice, some of our most flourishing cities, under a similar concurrence of circumstances, might not be involved in the same destruction. The modern parts of London are secured against the spread of fire by various provisions of the Metropolitan Building Act, and chiefly by the clauses which provide party-walls between all houses erected, and requires that they shall be *carried through the roof;* but we have not a similar act for every other English town, and the want of such an enactment was the greatest misfortune under which Hamburgh suffered at the time of the conflagration. The fire destroyed very many solid brick and stone houses, with party-walls, that might have resisted the flames, but the party-walls *had not been carried up through the roofs*, and the fire ran along the roofs and wooden cornices, and thus gained admittance to the upper and lower floors. In other respects, there was little more reason to anticipate the misfortune that has occurred, than a similar devastation of any of our ancient provincial towns."

The Hamburgh firemen, twelve hundred in number, are divided into three classes—life-savers, property-savers, and engine-men. Their fire-engines are of the most antiquated description, differing nothing in external appearance and equipment, and little in internal construction, from what they were a century and a half ago; they are of the description once known in England as the scale-beam engine, with the lever lying lengthways of the engine, and the handles placed crossways at each end. In power and efficiency, they are on a par with our smaller parish engines; they are adapted for eight men, and had originally three or four inch barrels, the suction-hose and passages, as in all old engines, being sadly too small. This original defect has, however, been greatly increased, by putting much larger barrels on to the old work. Immediately after the great fire, Frederick Huth, Esq. presented the city of Hamburgh with a new fire-engine, with 7-inch barrels, as used here by the London Fire Establishment; and the Hamburgh Senate purchased of Mr. Merryweather a still more powerful engine, with 9-inch barrels, as used by the Belfast and Liverpool fire police, &c. I was present at some trials with the latter in Hamburgh, which greatly astonished the inhabitants of that town. The engine being taken alongside the new prison, (late the Detention-house,) was worked by thirty-six soldiers of the garrison; Mr. Smith, the English engineer and proprietor of the water-works, affording an abundant supply of water from one of his mains. Upon the roof of the prison, (the highest building in Hamburgh, except the churches,) a number of persons had assembled to witness the trial, while the Senators and *élite* of Hamburgh stood around. The engine being equipped with one jet, 1⅛ inch in diameter, working commenced, and a splendid column of water towered magnificently over the roof, to the surprise and annoyance of the persons there assembled, and who had deemed such a feat impossible. Two jets of three-quarters of an inch were next applied, and the two streams thrown simul-

* I would beg to refer such of your readers as are desirous of further information on this subject to the *Westminster Review* for October, 1842, No. 75, which contains an excellent description of Hamburgh, and a most authentic narrative of the fire.

taneously over the building. In order to show the relative powers of this Goliah and the Hamburgh squirts, one of the latter was set to work alongside the "foreigner." The Hamburgh jet was only half an inch in diameter, and eight men were to be employed; as soon as the engine commenced working, however, eight more men got inside the handles, which they sent up and down like lightning, and thereby completely overreached themselves, as, from the smallness of the suction-passages and the rapidity of the strokes, the barrels had not time to get half filled with water, and the laborious exertion of the men was employed in churning water, which issued from the branch-pipe in a frothy foam. A jet could not be obtained—to the great discomfiture of the Hamburghers, and the gratification of the English, who mustered strong upon the occasion, and by their cheers paid due homage to the excellent production of their countryman. It is greatly to be regretted that the prejudice of the Hamburghers, and their antipathy to every thing that is English, (except their money,) will most probably prevent the useful employment of either of these splendid engines, until driven to the last extremities.

Notwithstanding the harmless character of London fires, the result of last year is considered as more unfavourable to the insurance companies in England than they have ever experienced; and it is stated from the best authorities, that, collectively, they have paid during the year, for losses by fire, upwards of one million sterling. This sum, of course, includes the great fire at Hamburgh, which caused losses to the English offices amounting to nearly half that sum. The losses by fire in Liverpool alone have amounted to considerably more than a hundred thousand pounds.

Incendiary fires have been lamentably numerous in the agricultural districts of England; and the frequency of these occurrences has induced many of the country towns and villages to put themselves in a better position for encountering fires than heretofore, by providing efficient fire-engines, and proper persons to apply them.

The county of Bucks, for some distance round the Duke of Buckingham's princely seat at Stowe, has on numerous occasions experienced the beneficial services of his Grace's excellent fire-brigade. Upon the occasion of a recent incendiary fire at Tingewick, three miles from Buckingham, the efficient exertions of Mr. Richard Merryweather, (superintendant of the Stowe fire-engines,) and his men, were described as beyond praise; and a meeting of the inhabitants was held, a few days after the fire, to express a deep sense of the obligation they were under to the Duke of Buckingham, for the very effectual assistance rendered by his Grace's engine, in preventing the spread of the fire. They also considered it due to his Grace's engineer, and the men under his command, to state that their conduct and exertions were most praiseworthy.

The West of England firemen have continued to exert themselves with their accustomed zeal and activity, whenever an opportunity has presented itself; in the provincial towns, however, they have had more frequent opportunities of distinguishing themselves than in the metropolis, during the period now under review. Their exertions at Crediton, Devonport, Limerick, Liverpool, and other places, have added considerably to their well-established reputation.

The conduct of the firemen of the London Fire Establishment, both officers and men, has been such as to procure the esteem of all with whom they have been brought in contact; while the promptitude and skill with which they have carried out the well-timed and judicious plans of their master-spirit have elicited the warmest approbation of their employers, and the thanks of a grateful public.

It is with unfeigned pleasure that I record the termination of the firemen's arduous duties in 1842, without the occurrence of a single serious accident to themselves; and to those who know the great perils they encounter, their continued preservation must appear little short of miraculous.

Wishing Mr. Braidwood and his gallant coadjutors a long continuance of their well-deserved prosperity,

I remain, Sir,

Yours respectfully,

Wm. Baddeley.

29, Alfred-street, Islington.
February 14, 1843.

MR. BAGGS'S CARBONIC ACID ENGINE.

The *Cheltenham Free Press* contains a very full report of a Lecture which was delivered last week at the Literary and Philosophical Institution of that place, by Mr. Baggs, on his ingenious and successful application of the expansive and condensable properties of carbonic acid, and ammoniacal gas to the production of motive power. The lecture was one of great ability, and had we not already given a full account of the invention, (see *Mech. Mag.* No. 1005,) we should have been tempted to transfer the whole of it to our pages; but we must, at least, find room for two extracts—one, in which he explains very clearly the sources of the new power; and another, in which he clears away, most successfully, the objections which have been made to its employment.

Application of Carbonic Acid, and Ammoniacal Gas, as a Substitute for Steam.

Carbonic acid is an invisible elastic fluid, about half as heavy again as common air; 100 cubic inches weighing 47 grains and a fraction. It is perfectly incombustible. Water dissolves about its own volume of this gas, but the absorption is much greater if the pressure be increased. Carbonic acid, in common with all other gases, expands by heat, the 1-459th of its volume for each degree of Fahrenheit. It is constantly present in the atmosphere to the extent of 1-10th per cent. The sources of its production in the great laboratory of nature are numerous, prolific, and unceasing. For experimental purposes it is generally obtained by the decomposition of one of the carbonates; and to produce it in the liquid form, we have only to maintain a constant generation of the gas in a sufficiently strong vessel, without allowing it any means of escape. It must not be forgotten, that in all cases of gaseous condensation, the liquid is formed at the coldest part of the apparatus, and nowhere else. A knowledge of this enables us to obtain an accumulation of the liquid at any desired point, and in any quantity. The mechanical properties of *ammoniacal* gas are closely allied to those of carbonic acid, but in its chemical nature it is totally different. It is a strong alkali — invisible, elastic, and very slightly inflammable. 100 cubic inches weigh 18·288 grains. Water at common temperature and pressure absorbs 780 times its volume of this gas. By strong compression it will take up considerably more. It is liquified under a pressure of 6½ atmospheres; carbonic acid requiring a pressure of 36 atmospheres at 32 deg. for condensation. It is an abundant product in many natural processes, and is always present in the atmosphere; though this latter fact has only been demonstrated by very recent investigations. When one volume of carbonic acid is mixed with two volumes of ammonia, both gases immediately lose their elastic properties, *and condense into a white solid, the carbonate of ammonia.* If water be present, the gases condense each other in equal volumes. It is of importance to bear these facts in mind, as we shall have occasion to refer to them again. The liquids I have been describing are exceedingly sensible to the influence of caloric, and their bulk and pressure are materially altered by a few degrees. 20 volumes of liquid carbonic acid at 32 deg. Fahr. occupy 29 volumes at 86 deg. At 12 deg. the elasticity of the liquid is equal to 20 atmospheres, at 32 deg. to 36 atmospheres, and when it is heated to a temperature of 86 deg. the pressure rises to 73 atmospheres, or 1·095 lbs. to the square inch. It may be congealed into a solid by the cold produced by its own evaporation, which is estimated at 180 deg. below zero; and in this state it forms the first instance of the solidification of a gas. The liquid acid at 32 deg. in expanding to gas at 60 deg., increases its volume 443 times. Ammonia, in undergoing a similar change, occupies about 1040 times its original bulk. These are a few of the principal facts bearing upon the present question, and we may proceed at once to discuss their application.

* * * *

If, then, we use as the materials for generating the gas, the carbonate of ammonia and some *fixed acid*, we shall obtain, in addition to the required gas, a definite salt, which, if exposed to heat, will give off all the volatile alkali, and leave the acid behind —*thus affording the exact amount of chemical material used in the commencement of the process;* and so the generation and recovery may be repeated indefinitely."

"I will now call your attention to the several objections that have been urged against this invention, and I hope I shall succeed in proving that they are wholly without foundation. Some over timid critics have deemed it *unsafe.* It cannot possibly be so, if the resistance is proportionate to the power. No one having a strong and fiery horse would seek to hold him in check with a few silk ribbons. The strength of the harness must be proportional to the power of the animal we intend to control; and the same system of proportional adaptation must necessarily be observed in the construction of our engines. Sir Isambard Brunel employed in the working of his ma-

chine a *much higher* pressure than is necessary here, and he himself told me, that in no single case did the slightest accident occur. I put the question, the other day, to a friend of mine who has had very considerable experience in the liquefaction of the gases, whether he had ever had the slightest apprehension of encountering any accident in his numerous experiments. His reply was, 'Never! my apparatus is made of a proper strength, and to show you my absolute conviction of its safety, if it were only well wrapped up in blankets, I should not have the slightest objection to take it to bed with me.' The next objection to which I shall refer is, that when an engine constructed upon this principle is working upon a large scale, any leakage or escape of carbonic acid gas would lead to the dissemination of a poisonous atmosphere. I am sure that with many of you this objection will be deemed unworthy of a reply; but as all my auditors are not chemists, I prefer to make the matter clear, and in order to do so in as strong a manner as possible, I will not take into consideration the idea of a mere leakage, but I will suppose that *all* the gas employed in the engine is thrown into the atmosphere the moment it has done its duty. What would be the result of this? Nothing baneful certainly—and a moment's consideration will convince us of this. When any portion of gas is thrown into the atmosphere, it immediately begins to diffuse itself in every direction according to an acknowledged law. Now, atmospheric air always contains, as I have before stated, one thousandth part by weight of carbonic acid. This proportion is the same all over the world; and the average quantity of this gas contained in the whole atmosphere is equal to 12,122 billions of pounds. The addition of a few billions more will not make much difference. Active volcanoes are constantly throwing off large quantities of the gas, and many springs are acting in a similar manner. The springs of the Elfil, a volcanic district near Coblentz, project into the atmosphere *every day* upwards of 110,000 pounds of carbonic acid. Every human being that has ever been in existence since the creation of the world has produced on an average every day of his life 25 cubic feet of carbonic acid gas by the process of respiration. Animals have been contaminating the atmosphere in a proportional degree, and 64·132 cubic feet of the same gas have been generated for every ton of charcoal that was ever burnt. Notwithstanding this continual and enormous addition, the constitution of the atmosphere remains the same; and though the science of chemistry is only of modern origin, we are nevertheless able to affirm that it has continued so for ages—for jars of air that have been buried in Pompeii for 1800 years, have yielded upon analysis the exact proportion of carbonic acid afforded by the atmosphere of the present day. Then, what has become of this immense quantity of gas? It is the food of plants, and has been removed by the respiration of their leaves. There is an incessant circulation of the elements of life, between the animal and vegetable worlds. Man is constantly destroying vital air and producing carbonic acid; and plants are as continuously absorbing the latter, and reproducing the former for the use of man: and if we managed to throw into the atmosphere *twice* the quantity of carbonic acid that we now generate, the inevitable consequence would be, that we should give rise to a luxuriant vegetation, which would shortly be followed by the restoration of an equilibrium. Another objection against the use of carbonic acid is that the intense cold produced by its spontaneous evaporation solidifies the gas, and destroys its elastic power. Abstractedly this is correct, but all will concede that it is most unphilosophical to separate the elements of a combination, and judge of the whole by a part. The disengagement of caloric by the *condensation* of the gas after it leaves the cylinder is so great that if the *generator* be subjected to its influence there will be absolutely a rise instead of a depression of temperature. Any one may convince himself of this by experiment. Some of the applications of this new power will be found of peculiar advantage. Wherever it is required to call into action an enormous force at a moment's notice, the liquifiable gases will prove most available agents in supplying the desideratum. Fire engines may be now transported from place to place without the least delay, and when they have arrived at the scene of destruction, the same power which brought them there will be capable of throwing them into rapid and immediate action. Carriages, whether for business or pleasure, will be equally obedient to our call, when filled with apparatus upon this principle. They will be ever in readiness for instant work, and may be kept in this state for months together without being attended by a fraction of the expense which is a necessary concomitant of horse-keeping. For war vessels again, this power would prove much more efficient than steam: for it stands to reason that, in order to be ready for any emergency, we must according to the present system be constantly wasting fuel to keep the steam up: whereas by the use of the new power, we should be in a position to gain a speed of fifteen knots an hour at a moment's notice, and thus obtain results the most glorious and decisive."

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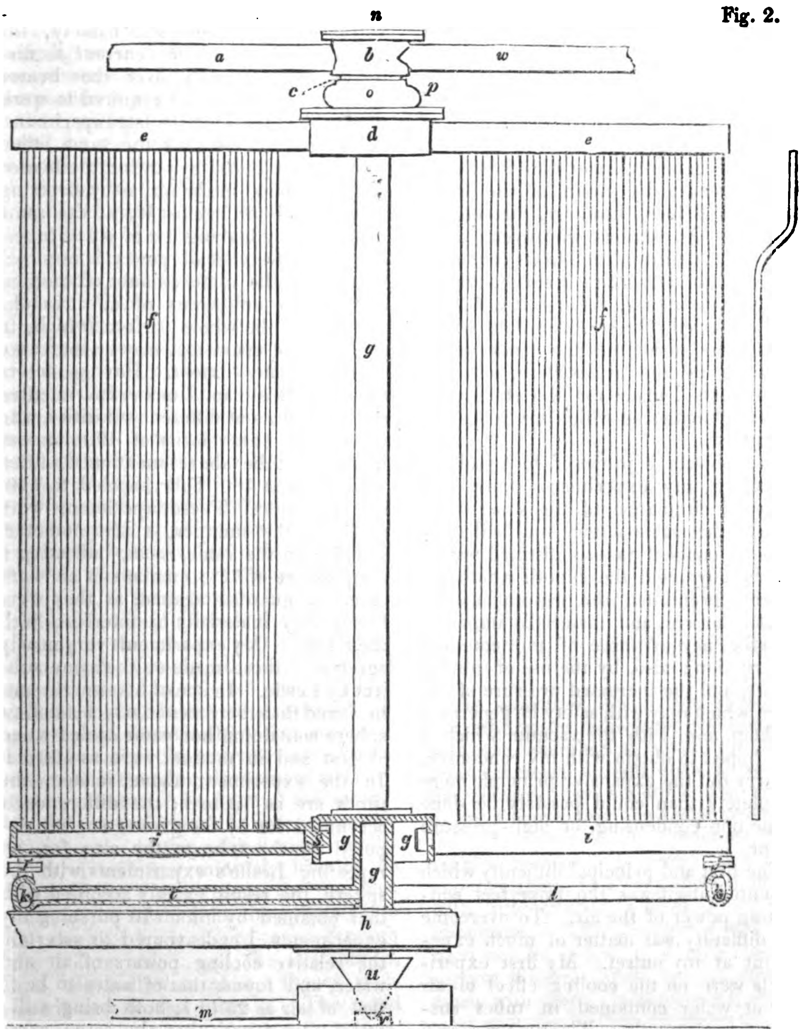
CRADDOCK'S PATENT STEAM BOILER, CONDENSER AND ENGINE.

Fig. 1. Fig. 2.



DESCRIPTION OF CRADDOCK'S PATENT STEAM BOILER, CONDENSER, AND ENGINE. BY THE INVENTOR.

SIR,—Some time ago you favoured me by the insertion in your Magazine of a few remarks relative to my patented inventions in generating and condensing steam (see *Mechanics' Magazine*, vol. xxxvi. p. 246); since that time the numerous experiments I have made on these subjects have led me to results which I believe will be interesting to your readers, and which, with your permission, I will proceed to lay before them.

By reference to my preceding communication, it will be observed that I there limited myself to the description of my patent condenser, and the detail of some experiments made with it in condensing steam, by means of the atmosphere. Before, however, proceeding to relate the various improvements I have recently introduced in its construction, and the important results obtained in my experiments, I think it advisable to relate briefly the considerations which induced me to attempt the condensation of steam by the atmosphere, and the experiments I made for the elucidation of the principles on which my invention is founded.

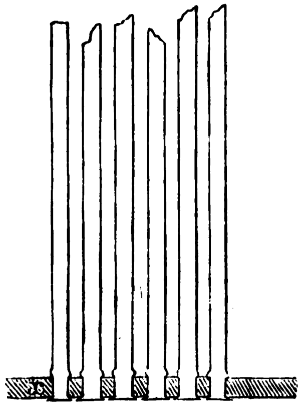
The objects I proposed to myself in instituting my experiments were, the continual circulation of the *same* water through the steam-engine and boiler, so as to be enabled to use distilled water, and thereby avoid the deposit which has hitherto prohibited the general use of tubular boilers, and materially impaired the efficiency of those of the common construction: also, by the use of tubular boilers, and the increased pressure of the steam which may with safety be generated in them, and, with the vacuum which I then hoped to obtain with my condenser, to carry out the expansive principle more completely than could possibly be done in the non-condensing, or high-pressure engine.

The first and principal difficulty which presented itself was the imperfect conducting power of the air. To overcome this difficulty was matter of much experiment at my outset. My first experiments were on the cooling effect of air on hot water contained in tubes suspended horizontally. The time required to reduce the temperature from about 180° Fahr. to 110° was 12 minutes; a time far too long to permit me to hope that any arrangement of stationary tubes would lose its heat with sufficient rapidity for the purposes of condensation. I then tried the effect produced by directing a current of air on the heated surface by means of a fan; although the cooling effect of the air was considerably augmented, still this method of cooling involves two great defects, namely, the difficulty of causing the current to distribute itself equally over the heated surface, and the power required to work the fan. On making the last experiment, it occurred to me that the same effect would be produced by putting the heated body in motion in the air, as by directing a current of air against it; at the same time that, by making use of small tubes, a comparatively small power is required to produce the same amount of motion, and perfect uniformity of effect is obtained over the whole surface, which, in this mode of operating, may be increased to almost any extent. Having determined on this plan, I next experimented on the effects at different velocities, and found that, at a velocity of 40 miles per hour, the tube above mentioned, filled with water at 180° Fahr., cooled to 110° in *one* minute. These experiments were made in the summer, a thermometer, standing in the same room, indicating a temperature of 70°; currents of air were carefully guarded against, as they were found very materially to interfere with the results. My experiments very nearly agree with those made on the same subject by Leslie. In one of his experiments he found that the times in which a hollow sphere containing hot water cooled when at rest and in motion, were as 10 to 1. In the experiment above related, the times are as 12 to 1; the difference is accounted for by the greater surface exposed by the tube to the air; for, on repeating Leslie's experiments with the sphere, the result exactly accorded with that obtained by him. In pursuing my experiments, I endeavoured to ascertain the relative cooling powers of air and water, and found that of water to be to that of air as 25 to 1, both being still; and I also found that the same cause which produced so greatly increased an effect in air was not less efficacious in

water, for on giving the heated tube a velocity of 2 miles an hour its cooling effect was doubled. I also find by my experiments, that motion in the heated body, whether in air or in water, increases their relative cooling powers as the temperature of the heated body, and that of the cooling medium approach each other; for example, at temperatures of from 180° to 120°, the cooling power of water, when the heated body moves in it at 2 miles an hour, compared with its cooling power when the heated body is still, is as 2 to 1; but 120° to the temperature of the cooling medium, the proportion is as about 2½ to 1.

In applying the principles above elucidated to the condensation of steam by the atmosphere, I constructed a model condenser in the following manner. A number of radial hollow arms were fixed near the top of a vertical axis, and a similar number near to the bottom of the same axis, and a series of copper tubes, of small diameter, were connected by their ends to these hollow radial arms; the steam was admitted from the top of the axis, and passing along the upper radial arms entered the small tubes, and there suffering condensation, fell into the lower radial arms; a pulley on the bottom of the axis served to impress on the model a rapid rotary motion. Here, however, a formidable difficulty presented itself; by the rapid rotation of the apparatus, the water collected by centrifugal force in the tubes most distant from the axis, and, as these became filled, it accumulated in those nearer to the axis, until, at length, the greater part of the tubes being full of water, the steam rushed uncondensed through the others. This difficulty was, however, overcome, together with several others that presented themselves in the course of my experiments, by arranging the parts of the condenser as shown in fig. 1 of the accompanying engravings. In order to render my remarks on this subject more intelligible, I will first minutely describe its construction. *a* represents the tube conducting the steam from the cylinder into the chamber *b*; it thence passes through the hollow axis *c*, and the chamber *d*, into the hollow arms *e*; thence it is distributed in the tubes *f*. The rapid rotation of these tubes about the axis *g*, produced through the pulley and band *h*, causes the rapid abstraction of heat, and consequently the condensation of the steam. The water falls into the hollow arms *i*, and being thrown by centrifugal force to their extremities, falls through the pipes *j* into the hollow ring *k*; a small tube *l*, communicating with the ring *k*, passes into the hollow axis *g*; *m* is a tube connected with the chamber and axis *g*, and the air-pump worked by the engine. *n* is a lid covering the chamber *b*, in which is contained the stuffing-box for making the revolving axis *g* work tight; *o* is a small cup, for holding water or oil, around the stuffing-box, which is thereby rendered more tight; *p* is a cover, which screws in halves on the chamber *d*, in which chamber the upper radial arms *e* are fastened; the mode of fastening these arms by a screw and nut is shown

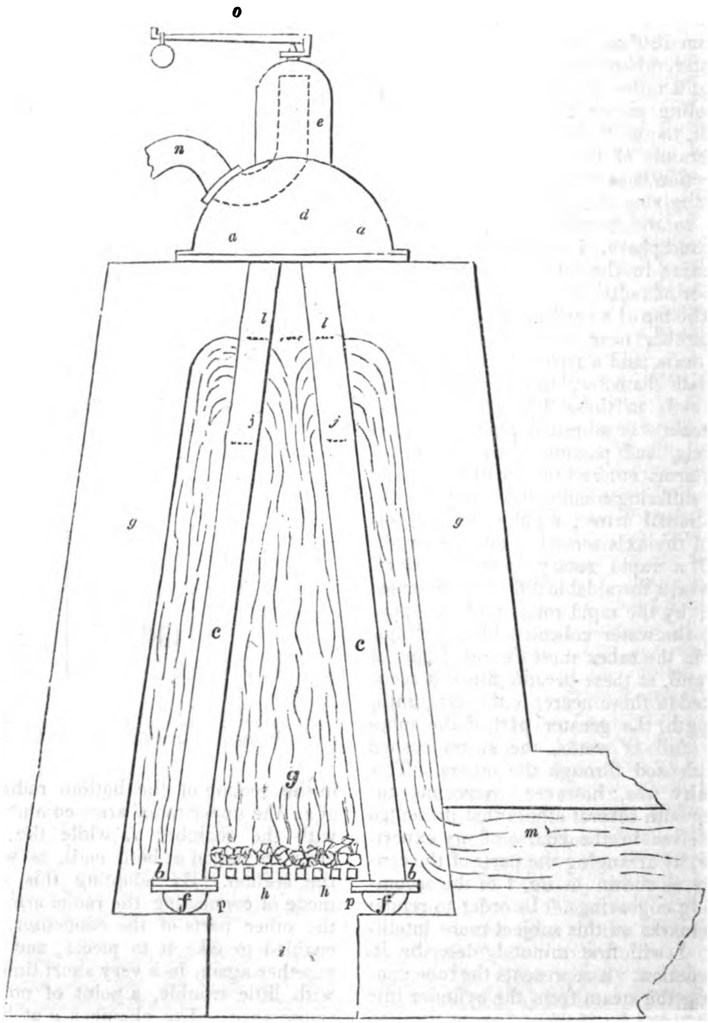
Fig. 3.



in the section of the bottom radial arm at *s*; the upper radial arms communicate with the chamber *d*, while the lower arms are closed at both ends, as seen in the section. By adopting this simple mode of connecting the radial arms with the other parts of the condenser, I am enabled to take it to pieces, and put it together again, in a very short time, and with little trouble, a point of no small importance. The chamber *g* at bottom need not be closed, as it only serves to support the arms *i*, and does not communicate with them. *u* is a cup which contains water for making the lower stuffing-box tight; the point of the axis (shown in dotted lines) works in the cup *v*. It

will be well to observe that the lower part of the axis *g* does not communicate with the tubes of the condenser, excepting through the tubes *l*, and the ring *k*. *w* is an arm for supporting the top of the condenser, which may be fixed in any convenient situation. Fig. 2 represents a side view of one of the tubes *f* of the condenser, and exhibits the form into which it is bent at its upper part, so as to allow of a slight elongation and contraction, without tearing it from its

Fig. 4.



joinings. Fig. 3 shows the method of fixing the tubes in the plates, previous to their being screwed on the radial arms; the plate *x* is tinned after the holes for the insertion of the tubes have been drilled in it; after the tubes (the ends of which are also tinned) are put into the holes, they are swelled by a proper tool, so as to fit the hole tightly; at the same time a shoulder is swelled out on one side

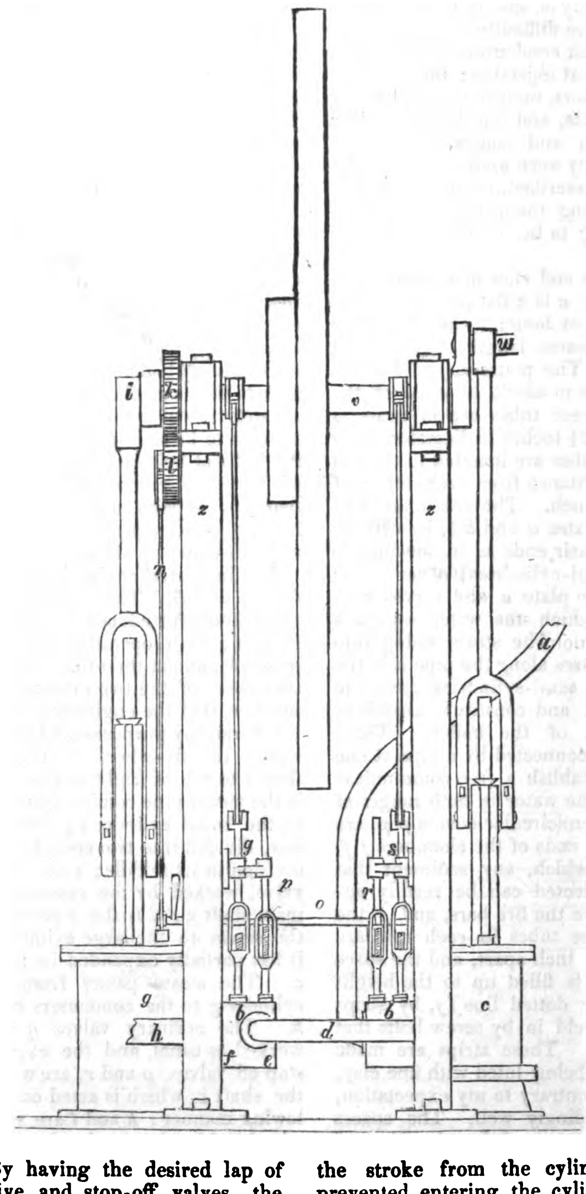
of the plate, and the end of the tube flanged on the other side. The plate or leaf, on the tubes thus fixed in it, is then dipped in melted tin. The whole becomes, by this means, so firmly united, that the joints may truly be said to be the strongest parts. The difficulty of securing the joints of tubular condensers used in water has been a great objection; the difficulty in my condensers, used in the air, became most formidable, and was heightened by the elongation and contraction of the tubes when they were used straight. The form of tube described, together with the mode of joining them into the plates, leaves nothing to be desired in this department.

Fig. 4, is an end view of my improved tubular boiler; *a* is a flat plate 18 inches wide and 6 feet long; *bb* are two other plates of the same length, but only 10 inches wide. The plates *a*, and *b b*, are bored out so as to admit the ends of the tubes *c c*. These tubes are of brass, 5 feet long, and 2½ inches in diameter. The two rows of tubes are inserted in the top plate *a*, at a distance from each other of only half an inch. The tubes are fastened in the plates *a* and *b b*, by driving ferules into their ends as in locomotive boilers; a semi-cylindrical cover *d*, is screwed on the plate *a* and serves as a reservoir in which the water separates from the steam. The steam rising into the dome *e* passes along the pipe *n* to the engine, *f f* are semi-cylindrical covers to the plates *b b*, and constitute chambers at the bottom of the boiler. These chambers are connected by a pipe at one end so as to establish a free communication between the water in both ranges of tubes. Two semicircular covers *p p*, are screwed on the ends of the chambers *f f*, by removing which, any sediment that may have collected can be readily removed; *h h* are the fire bars, and *g* the fire box. The tubes in each row are placed half an inch apart, and the space between them is filled up to the height denoted by the dotted line *j j*, by strips of cast iron held in by screw bolts that clip the tubes. These strips are made to fit tight by being luted with fine clay, which I find, contrary to my expectation, answers exceedingly well. The spaces between the portions of the tubes situated above the dotted line *l*, are also filled by the brickwork to prevent the fire acting on those parts of the tubes not containing water. The spaces between the tubes from *l* to the line *j* being open, the heated air and flame pass out there, and descending on the outside of the tubes, give out another portion of heat to them. The smoke and heated air eventually pass to the flue by the passage *m*; *g g* is the brickwork enclosing the boiler; *i* is the ash pit; and *o* the safety valves. The fire grate is 18 inches wide and 6 feet long. I prefer dividing the fire grate into two parts by a bridge, and feeding it at both ends. By this means the production of steam may be made more steady, as the fires need not be supplied with coal at the same time. This mode of construction also affords a large grate surface, and consequently a slow combustion of the fuel, which I am disposed to think more economical than quick combustion. Where a large supply of steam is required, I prefer two small boilers to one large one. I believe that a careful consideration of the construction of my improved boiler will show it to be a simple and efficient one; it admits of being easily cleaned out; and all its joints are readily accessible; so that any repairs may be easily made; it is altogether simple in its construction and consequently cheap.

My improved engine is represented in figs. 5 and 6. The object of the improvements introduced in this engine is to bring into operation the expansive principle, and at the same time to dispose the cranks of the two cylinders in such a manner, that the engine shall be applicable to railway purposes, and all situations where the fly-wheel is objectionable; that is to say at right angles. *a*, fig. 5, is the steam-pipe coming from the boiler to the small cylinder *c*; *b* is the valve-box, divided into two compartments by a division in its middle; *s* is the ordinary valve, worked by the eccentric *t*, on the main shaft *v*; *d* is the pipe that conveys the steam to the large cylinder *g*, after it has partially expanded in the cylinder *c*. The steam passes from the large cylinder *g* to the condensers by the pipe *h*. The ordinary valves *q* and *s* are worked as usual, and the expansive and stop off valves, *p* and *r*, are worked from the shaft *v*, which is acted on in the following manner; *k* and *l* are two toothed wheels taking into each other; the wheel *k*, which has twice the number of teeth that the wheel *l* has, is fixed on the main shaft *v*, and the wheel *l* works on an axis

on the frame *z*; an eccentric is fixed on *l*, and the clip of the eccentric is connected to the rod *n*. By this arrangement the expansive and stop-off valves are opened and closed twice to every opening and closing of the ordinary

Fig. 5.



valves. By having the desired lap of the expansive and stop-off valves, the steam may be cut off at any part of the stroke from the cylinder *c*, and prevented entering the cylinder *g*, until the piston is in a proper position to re-

ceive it; *n* is the projecting crank pin to which the connecting rod working the lever *x*, of the air-pump *y*, (see fig. 6,) is attached. 1 is a pipe connecting the air-pump with the condenser, and through which the water and air are drawn from the condenser and the vacuum maintained; 2 is a force-pump, which forces the water from the cistern, 3, to the boiler.

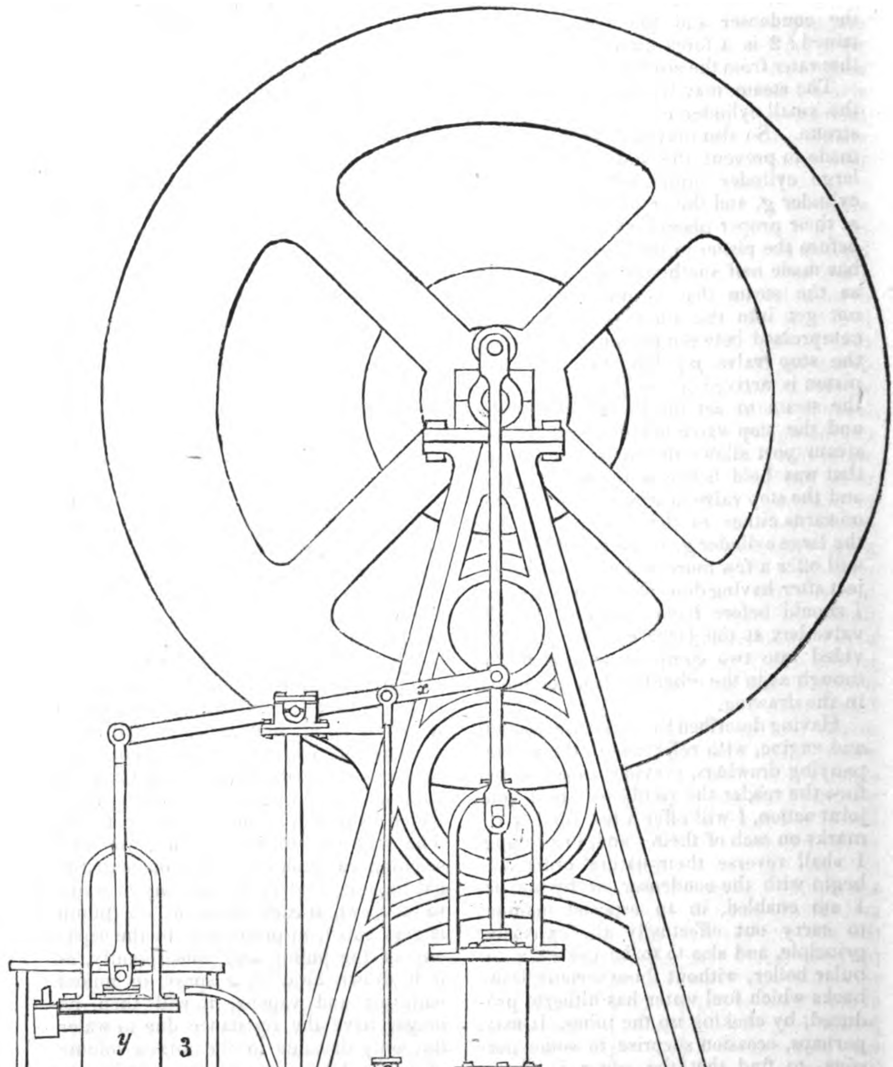
The steam may be cut off on entering the small cylinder *c* at any part of the stroke. So also may the stop valve *p* be made to prevent the steam entering the large cylinder until the piston in the cylinder *g*, and the crank *i*, have arrived at their proper places, which will not be before the piston in the small cylinder *c*, has made half another stroke; of course, as the steam that is underneath cannot get into the other, *g*, it must be compressed between the small piston and the stop valve *p*; but now the large piston is arrived at its proper place for the steam to act most efficiently on it, and the stop valve being moved off the steam port allows the compressed steam that was held between the small piston and the stop valve to urge the large piston onwards either to the top or bottom of the large cylinder *g*, as the case may be. I will offer a few more remarks on this subject after having described the other parts. I should before have observed, that the valve box at the large cylinder *g*, is divided into two compartments, *e* and *f*, though as in the other box it is not shown in the drawing.

Having described the condenser, boiler, and engine, with reference to the accompanying drawings, previous to laying before the reader the results of their conjoint action, I will offer a few further remarks on each of them; and, in so doing, I shall reverse their natural order, and begin with the condenser, as by its use I am enabled, in an especial manner, to carry out effectually the expansive principle, and also to make use of a tubular boiler, without those serious drawbacks which foul water has hitherto produced, by choking up the tubes. It may, perhaps, occasion surprise to some persons, to find that the water is drawn by the air-pump from the ring *k*, instead of from the centre. It is therefore necessary to anticipate the difficulty, by stating that, if the water were drawn by the air-pump direct from the radial arms towards the axis of the condenser, the steam would in a great measure be drawn off uncondensed, as by an inspection of the figure it will be evident that it would thereby be taking a much shorter course, than by passing through the tubes near the ends of the arms; while the water would choke those tubes, and the action of the condenser cease. By the present arrangement, however, the water falls into the ring *k*, and is no longer capable of interfering with the passage of the steam through the tubular parts of the condenser. It may perhaps be well to put the matter in another form. The water, being the heavier body, would by centrifugal force be held at the circumference, and a pump working at the centre, and through the lower radial arms, could have no effect in drawing the water from thence, so long as there was a passage for the steam near the centre; it therefore becomes necessary to draw the water from the circumference, in such a way, that the water must be drawn off before there is a passage for the steam. This is done in the arrangement described. In my first experiments, I removed the water from the ring *k* by fixing a small pump on it, the piston-rod of which worked on a fixed eccentric, supported around, but unconnected with the axis of the condenser. The pump travelling on the ring *k*, round the fixed eccentric, its piston was worked to and fro, and the water removed.

The centrifugal force is only 3 inches of mercury at 80 revolutions per minute, and, contrary to my expectation, at 120 it is not at all increased; so that in its present state I do not think it worth while to attach the small pump to it, as all it can gain are the 3 inches of mercury, from which its own friction must be deducted. The way in which I account for this seeming violation of the law of centrifugal force is, that as the quantity of water to be drawn at each stroke of the pump is very small, in proportion to the capacity of the pump, and, consequently, as it is drawn away in a spray, or mixed with air and vapour, it will then no longer have the resistance due to water but only that due to the mixed volume of water and air or vapour, according to their respective proportions. The part the condenser acts, in enabling me to get an increased effect from the expansive property of steam, is twofold. The first, and most important, is in the vacuum obtained by it, which is, as will be seen in the table, from 18 to 20 inches of

mercury; and it frequently is as high as 25 and 26 inches, although this is less than the vacuum obtained by water, by about 6 inches of mercury. There is a difference in favour of my modification not to be overlooked, that is, the steadi-

Fig. 6.



ness of the vacuum I obtain: at no time does it oscillate $\frac{1}{16}$th of an inch, whereas in most condensing engines I have seen there is a considerable oscillation, the mean of which is the real vacuum. I am here speaking of my vacuum in the exhaust pipe that comes from the cylinder; and of course this is clear of centrifugal

force, as on the air-pump side of the condenser the gauge stands at 23 inches, and here it oscillates from 2 to 3 inches. Another advantage resulting from the condenser is, its ensuring us pure water, thereby enabling us to use tubular boilers, and by them steam of high pressure with perfect safety. It thus, as it were, adds to the available effect of the expansive property of steam at both ends, by increasing its pressure at the outset, and enabling us to take advantage of its expansion to almost its lowest point.

In all these remarks, except the allusions to the better vacuum obtained in water, I have had in view the high-pressure or non-condensing engine. I am not so much taken up with condensing by means of the air, as to prefer it even to water, where there is plenty of that liquid. My object, as to air-condensation, is to take up the question where all other modes are obliged to leave it, and thus to make the condensing engine universally applicable. But where water can be had, my plan will be found to be inferior to none, either in principle or practice. And here I need not dwell on the few observations and experiments given at the commencement of this paper, with the well-established correspondence between the laws of water and air as fluids, in most of the particulars now under consideration. There is one objection that is made to my plan in water which I will just notice, and at some future time I may offer some further remarks on my mode of condensing in water. The objection made is the resistance its motion would occasion in water. I am not totally ignorant of the law of resistance at various velocities, and of the influences the form of the body has on such resistance; without, however, attempting to apply the various theories and calculations that have been given on this subject, it is sufficient for my present purpose that I feel convinced from observation, and hope shortly to be able to demonstrate by experiment, that the objection is totally unfounded, owing to the very slow motion I shall require to give it in water, as well as the form of the body being favourable to the dividing, as it were, of the water. I know, also, that a motion of only two miles per hour doubles the condensing effect by the same surface. But more on this subject hereafter, as I do not like to go far beyond what actual experiment has demonstrated.

In attempting to give a clearer explanation of the advantages arising from the use of two cylinders, and also some further observations on the little I may have added to the engine, I make no pretensions to any thing new in the use of two cylinders, but I think them highly useful in the carrying out of the expansive principle. And here I will take the engine I have been describing to illustrate my views. It is contended by many, that one cylinder is equally good with two, on the expansive principle; and perhaps in the power given out, in proportion to the steam used, they are right; but in the regularity with which the engine moves its load, I cannot agree that one cylinder is equally good with two; for to use steam expansively, and to the extent, would render a long cylinder necessary, or the piston must move through a very small space before the steam is cut off, and to cut off which, the expansive valve would require to move very quickly. Nor would this be all. The piston would start with a pressure acting on it, including the atmosphere, equal to 100 lbs. per square inch; and before it terminated its stroke, its pressure would not be above 10 lbs., still including the atmosphere, or from 4 to 5 lbs. under the atmosphere. This, of necessity, must produce a very irregular motion in the engine, and whatever it was moving. Now this is just the circumstance under which the engine above described works, only that, instead of a large cylinder, and cutting the steam off at one-sixth of the stroke, the steam acts at full pressure in a small cylinder, and, subsequently, expansively in a larger one. A positive advantage, however, results from the use of an engine having a short cylinder, and a quick succession of strokes, compared with a long cylinder, and consequently slow succession of strokes, which must not be overlooked, namely, a greater regularity of motion; for while the latter communicates its impulses at long intervals, and the acquired momentum of the machinery is being exhausted between those intervals, the former communicates its impulses in such quick succession, that the momentum is little exhausted between them, and a consequent steadiness of motion in the engine, and the machinery actuated by it, results. But whatever may be the speculative opinions about the matter, my engine certainly works with scarcely any perceivable difference of motion in the old way; and when the cranks are placed at right angles

to each other, it is as uniform as can be desired—at least, there is not the slightest perceivable variation. The simple reasoning which leads me to believe I could cause the steam to pause, as it were, until the large piston, in putting its crank at right angles to that of the small one, should be in its proper place to receive it, may be illustrated in this way. By taking two small syringes, and connecting their lower ends by a tube, when the one piston is at the bottom and the other at the top, this last syringe under ordinary circumstances would be full of air; on pressing its piston down, that of the other would rise; it only remains now to have a stop-cock in the pipe that connects the two syringes, to make it resemble the action of my two cylinders, and to keep the cock shut until the piston at the top is forced half way down. Now on opening the stop-cock the two syringes communicate with each other, and supposing there is no friction the whole force taken to compress the air into half its space in the first syringe would be given out in raising the second piston from the bottom half way up its cylinder. Thus it seemed clear to me, that the loss by compressing the steam between the exhaust side of the small piston and the stop-valve would be nearly all given out by the compressed steam reacting on the large piston. Experience has fully confirmed my anticipations, for both by the gauges and the quantity of water taken to work the engine, it differed but very slightly from the old way; the quantity of water or steam per hour required to work the engine was only 9lbs. more with the cranks at right angles than the other way. The advantages that my mode of working the stop and expansive valves has over that of the common and all other modes that I am aware of, is that by the simple means of giving the shaft a double motion by means of the toothed wheels and eccentric, I get that desirable motion so free from sudden stops and starts which rendered every other mode I can find in use unavailable; for while my engine was making from 70 to 80 strokes per minute, owing to this rapid reversal of motion, the machinery on the old modes was continually knocking itself to pieces; the noise, too, was very objectionable.

The first remark I have to offer on boilers, is, that a tubular boiler is not essentially necessary to my principle of using steam; for as the Table at the end will show, so greatly increased an effect is produced by a given quantity of water converted into steam by my mode of using it, that a boiler of the ordinary construction may be made so small as to produce the requisite quantity, and yet be perfectly safe; for the ordinary non-condensing engine requires 120lbs. of water per hour, per horse power, and my engine requires only 30lbs. And here I would observe, that though in the experiments in the table I made use of steam of 85lbs. above the atmosphere, I will not yet be positive that a less pressure will not be found equally economical, though I am disposed to believe that about 80lbs. with tubular boilers will be more economical than steam of lower pressure. But on this I hope to try a series of experiments shortly, so as to be able to determine to my own satisfaction at least, all things being considered, what is the best pressure in point of economy. Yet it does appear to me, that considering the many advantages the tubular boiler possesses over the other in point of safety and compactness, or the capability of generating much steam and yet occupying little room, the day will come when it will be very generally used; the more especially, that in conjunction with the expansive principle of using steam, it is so peculiarly suited for steam-vessels which are intended for long voyages, the quantity of coals required being greatly diminished, and the room occupied by the boiler being much less. But here will occur the objection commonly urged against high pressure steam, that of danger—an objection that certainly does not seem to me well founded when applied to tubular boilers, for such boilers are almost beyond comparison more safe even with 100lbs. on the inch, than is the common boiler with 6lbs., inferring, as I do, that the actual strain on any part tending to rend it asunder, is as the pressure of the steam multiplied into the area of the boiler. If this inference be just, on comparison with the best form of boilers, the cylindrical, and supposing it to be 4 feet in diameter, and on taking the number of inches in its circumference, and supposing the pressure to be only 6lbs. per square inch above the atmosphere, I find the boiler would have a force equal to 900lbs. on every part of it tending to rend it asunder. If we com-

pare with this a tube of 3 inches in diameter, and even at a hundred pounds on the square inch, we have but little above 900lbs. as before, on every part of it tending to rend it asunder. But supposing these two vessels to be rent asunder by the pressure of the steam within them, how different would be the consequences! The action of the tube would be very limited, most probably no other than putting out the fire and making the boiler unfit for use until a fresh tube was put in; but the consequence of the large boiler bursting may be the total wreck of the vessel with a tremendous sacrifice of human life; and on the most favourable supposition, the boiler would be rendered quite useless. One thing ought not to be lost sight of when considering the danger from a boiler bursting—the quantity of explosive matter at once set free, and especially the quantity of water. For although water in its ordinary state cannot with propriety, perhaps, be called explosive, yet next to the solid parts of the boiler flying in all directions, this is the most dangerous element; indeed, it may be questioned whether in the bursting of a small vessel containing steam only, there is any danger, except from the solid matter of the boiler flying in fragments or being moved from its seat altogether. But perhaps it will be objected that my boiler does not in all its parts partake of the safety of the 3 inch tube; to this I reply, that those parts are not acted on by the fire, and therefore are not liable to be injured by it, and as the heat is not required to be transmitted through these parts, and as they form but a small part of the boiler, they may be made of such a strength as to preclude the possibility of its bursting before the tube. This may be done without greatly increasing either the expense or weight of the boiler, or in any other way detracting from its utility.

The following is the Table several times referred to in my remarks. It gives the results of a series of experiments made with the engine. The pumping of water was chosen as the best test of its capabilities. An inspection of the Table, will show that the power required to work the engine itself does not exceed one-fourth of the whole.

	1. Pressure on small piston. lbs.	2. Resistance on small piston. lbs.	3. Available pressure on small piston. lbs.	4. Pressure on large piston. lbs.	5. Resistance on large piston. lbs.	6. Available pressure on large piston. lbs.	7. Available pressure on both pistons in pounds lifted one foot per minute. lbs.
Engine at work, condenser still.	18	5½	12½	5½	3	2½	154,050
Condenser revolving at 120 per minute....	27	7½	19½	7½	4	3½	226,766
Pumps worked, but not lifting water........	46	11	35	11	4½	6½	414,400
The pumps lifting water 24 strokes per minute 3 feet stroke, and each bucket having 256 sq. inches. The lift 17 feet.	100	20	80	20	6	14	918,160

The small piston has an area of 8 square inches, and in all the experime ts travelled through 146 feet per minute. The large piston has an area of 154 square inches, and in all the experiments travelled through 220 feet per minute. The resisting pressures shown in columns 2 and 5, are obtained by subtracting the

vacuum as shown by the gauges from atmospheric pressure, the latter being always taken at 15 lbs. on the inch. In the last experiment the resistance was 20 lbs. on the inch, being 5 lbs. above the atmospheric pressure. Column 1 shows the pressure of the steam, including the atmospheric pressure on the large piston. Column 3 shows the available pressure on the small piston, and column 6, the available pressure on the large piston. The pressures were obtained by mercurial gauges attached to the steam and vacuum sides of each piston. The mercurial column oscillated in most of the experiments; in those cases the mean was taken. I remain, Sir, &c.

T. CRADDOCK.

Birmingham.

WOODEN PAVEMENTS.

" Old men and beldams in the street
Do prophecy upon it dangerously."—*King John.*

Sir,—Every person conversant with the past history of science will admit that few inventions have arrived instantly at perfection, and that, in the infancy of any new or striking improvement in any of the arts of life, there has ever been a numerous and annoying (though not a formidable) class of detractors, who, by magnifying real evils, and conjuring up the most horrible imaginary ones, have raised a continual and clamorous outcry against the "dangerous innovation." But experience likewise tells us that, notwithstanding the opposition thus raised, and the difficulties purposely thrown in the way of improvement, ingenuity and perseverance have ultimately succeeded in removing all real defects, and showing the perfect fallacy of others which never existed but in the jaundiced and perverted eyes of the "overwise in their own conceit." One of our latest public improvements—wooden pavement—furnishes an apposite illustration of the foregoing proposition. The slow progress of this improvement is somewhat remarkable; although the important advantages and great utility of wooden pavements have been long established on the Continent, this "innovation" was received with great suspicion in the metropolis; and it was not until numerous specimens had been very thoroughly tested, that any progress was made in its extensive application. It has, however, as everything really good always must, gradually extended itself, until London can boast of a very extensive surface of pavement now covered with wood; and the consequence is, that the expediency of certain adaptations to our immense and peculiar traffic are beginning to develope themselves. But no sooner is a trifling defect discovered, than the "alarmists" raise a terrible outcry, and a sapient alderman goes so far as to move that the wooden pavement in the city be taken up! A large majority of those to whom he appealed, however, were more reasonable, and instead of the wooden pavement being taken *up*, the wooden alderman was taken *down*. All the beneficial effects of wooden pavements cannot be fully realised in the metropolis until its adoption has become universal; its safety, cleanliness, durability, and economy will then be demonstrated. The principal—indeed the only—defect, upon which the opponents of wood paving ground their opposition, is, its slipperiness; and even this is greatly overrated to give plausibility to their extreme hostility. Experience having shown that a greater number of accidents occurred on the small piece of wood pavement in the Poultry than elsewhere, a sergeant of police was deputed to record the number of accidents, and if a horse made the slightest stumble, he was immediately "put down," to swell the sum total of "miscarriages."

The injustice of taking any small isolated spot to establish a point either *pro* or *con*, must be manifest, and a five-and-twenty years' acquaintance with the Poultry traffic enables me to state that, even in the good old times of stone pavements, more horses fell, and more serious accidents occurred, in the Poultry than in the whole of Cheapside and Cornhill put together. The accumulated traffic of the two great main lines of Holborn and the Strand, before branching off to London Bridge or Whitechapel, become concentrated in the narrow passage of the Poultry, thereby increasing the liability to accidents in that particular spot apparently beyond what is but a per-centage of the whole. The effect of such a traffic is, however, to cause a wear and tear, and consequently a slipperiness of surface, in this confined spot, beyond that of other pavements, and for which due provision should be made.

When the adoption of wooden pavements becomes universal, there will be little difficulty in adapting the shoes of

horses thereto, so as to insure good foothold under all circumstances, and ingenuity is already at work in this direction.* An adequate amount of talent, however, seems to be directed towards remedying the defect of slipperiness in the pavement itself, and in one specimen as laid down before St. Giles's church, (Rankin's patent,) the object is effectually accomplished. But the slipperiness of surface is got rid of in this case at a cost which would seem to preclude its general adoption, and there is no reason why an equally advantageous surface should not be produced by some much less costly and complicated structure. It has been found on the Continent, that sand cemented to the surface of the wooden blocks by tar, &c., will prevent slipperiness, and the adoption of a similar remedy is suggested here; but I apprehend the treatment would avail but temporarily against the destructive agency of London traffic. *systematic and sufficient grooving* would seem to be the only certain remedy, and this has been abundantly provided for in the improvements in wooden pavements recently patented by Mr. Bunnett. Whether this remedy should prove effectual or not, we need not despair: ingenuity is still actively engaged, and every month tells us of fresh patents granted for "improvements," some one of which will doubtless accomplish what is requisite, viz., the rendering of wood pavements by far the *most safe*, as it is really the most comfortable and agreeable (both to passengers) ever yet devised.

The "silent system" of transit over wooden pavements calls for more caution on the part of pedestrians, and much greater carefulness on the part of drivers, than either have hitherto been in the habit of exercising. The latter, however, can hardly be expected, if every instance of reckless driving and consequent loss of life, is invariably put down as an inevitable result of the "barbarous innovation," and the most flagrant instances of guilt allowed to go unpunished, in order to justify the violent clamours and malevolent prejudices of those who scruple not to take any road leading to notoriety.

"Killing no murder" is now the order of the day! Drive on then, ye modern Jehus, and let your wheels rival those of Juggernaut; all the blame lies in *wooden pavements;* "the law allows it, and the court awards it."

I remain, Sir,
Yours respectfully,
W. Baddeley.

29, Alfred-street, Islington.
March 4th, 1843.

* Perhaps the American plan of pointed steel studs to screw into the horse-shoe is as good as anything that has yet been suggested.

SCREW PROPELLERS.

Sir,—Mr. Wimshurst, in reply to my communication, has not complied in any one particular with my request, but only proffers to show me what the "Novelty" is capable of doing in the "broad face of day." Mr. Editor, this is not supplying *facts* which would assist me and your numerous readers to arrive at the comparative merits of screw propelling in comparison with the common wheel. I can compare Mr. W.'s mode of procedure to nothing so aptly as that of a tradesman who should endeavour to ascertain the profits arising from an undertaking without knowing the expenses required to be deducted. If Mr. W. will but favour us with the consumption of fuel, we can then possibly judge whether the *Novelty's* performances are as astonishing as Mr. Wimshurst would have the world to believe; and I beg leave most respectfully to suggest to that gentleman, who I am ready to acknowledge has assisted most liberally in the cause of steam navigation, that by suppressing this one item, all his other facts are utterly useless. With regard to the speed of the *Novelty*, I find on referring to Galloway's Appendix to Tredgold, (D, p. 59,) the following passage, which proves that I am not singular in my estimate of that vessel's rate of steaming: "The *Novelty* passed the *Swiftsure* at the rate of nearly a mile per hour, and as the *former* has *never* exceeded 7 *miles*, we may conclude that the speed of the *Swiftsure* did not on that occasion much exceed 6 miles per hour." Mr. Wimshurst thinks that I did wrong in referring to Tredgold as an authority, because it is to be inferred from a certain passage, that the author "refers to *paddle-wheel* and not *screw* vessels." Now, Mr. Editor, I have yet to learn in what respect the application of any particular plan of propelling has to do with the *increased resistance* due to an *increased velocity*. Perhaps Mr.

W. will oblige us with *his new theory* on this subject, for, as at present informed, his views appear to me at utter variance with all research, from the days of Galileo to those of our own.

While on the subject of the screw, Mr. Editor, perhaps you will allow me to make a few remarks on what has been previously done in this line. In your Part for November, 1842, there is inserted (p. 460) a paper by Mr. Lowe, tending, as *he* states, to set the history of screw propelling in a correct point of view, and to disabuse the public mind of certain impressions promulgated from "*sinister* and *disingenuous* motives." Now, Mr. Editor, the only history of the screw propeller that I can trace in that communication, is one tending to *mislead* the public. Mr. Lowe does not state by whom the *Hope* was fitted, and to me the only purport of his paper seems to be to prove the *imagined priority* and wonderful performance of *Self and Company*. I find that the screw was proposed so far back as 1727, and again in 1768, (see Galloway's Appendix. D, p. 3,) under the name of the "Pterophore," which was stated to be the circumvolution of a thread of a *screw* round a cylinder. In the latter case, two of these instruments were proposed to be used and placed horizontally, and parallel to the vessel's length, or only one at the stern, the size of which was to depend upon that of the vessel, and the curvature of the thread on the velocity with which it was proposed to row. On referring to your earlier volumes, I find the screw also proposed in March, 1824, (Vol. 2, No. 31,) in the following passage of a letter from a correspondent, "I have always been of opinion, that a wheel of this kind (a spiral wheel) would be better adapted for steamboats than the common paddle-wheel." Again, on the 9th of April, 1825, (Vol. iv. No. 85,) a writer, with the initials, T. M. S., takes the following just view of the subject:

"The mode of propelling steam-vessels, to which I would call the attention of your intelligent correspondents, particularly those engaged in constructing or navigating them is to substitute for paddle-wheels a worm-like spiral wheel, (if it may be so called,) that shall work in the water in the manner of a *screw*, to be formed by a flat board or ledge wound spirally round an axle, just like the screw of Archimedes without its external rim, one of those on each side of the vessel, placed with their axles longitudinally, at any depth that may be found convenient, but somewhat below the water's surface, would produce a progressive motion accompanied by very little collateral resistance, with a very gentle agitation of the water, and with very small loss of power."

The writer afterwards states what in practice has been found, I believe, correct:—

"An objection may be founded on the *velocity* of the rotary motion required to produce a given progressive motion. It is easily perceived that the progressive motion acquired in one revolution of the spiral wheel cannot exceed the distance of its threads from each other, but must, indeed, be somewhat less, owing to the yielding nature of the water; whilst that obtained by one revolution of the paddle-wheel bears a great proportion to its circumference. But this objection will, I think, be overbalanced by the diminished force required to turn the spiral wheel, and the small proportion of it that will be inefficient."

So much, Mr. Editor, for *priority of ideas*. All these things prior to the performance of Messrs. Shorter and Lowe in 1826! Models of the screw as a propeller were also laid before the Lords of the Admiralty in 1827, by your intelligent and talented correspondent, Col. Macerone; but no accounts of his plans or experiments have as yet, I believe, been laid before the public. Mr. Lowe, in his *true* history, states that his patent was sealed in March, 1838; but he *forgets* to chronicle, as a correct historian should, that Ericsson had taken out a patent (and that, too, not for a whole screw, but for portions thereof) in 1836. If Mr. Lowe intended to give a *correct* history, he ought, if not capable of so doing himself, to have summoned to his aid some learned antiquary to assist him in his researches through a space of just *twenty months* anterior to the date of his own patent, who would undoubtedly have discovered for him that one Church took out a patent, in October, 1829, for not a *whole screw*, but one cut in pieces; and that, in December, 1832, one Charles Cummerow also took a patent for a *screw*. I should not have introduced the latter from a herd of others, were it not for a note appended to an account of it which appeared in Newton's London Journal (Vol. 8. 2nd series, p. 144.) After describing the patent, the writer

says, "There is an elaborate description given in the specification of the invention, *but its want of novelty* is so obvious, that it is not necessary for us to say more upon the subject." All these patents, and *quasi* patents, are *prior* to Mr. Lowe's of 1838. Of a verity, "those who fling stones should not live in glass houses." Mr. Lowe also *omits* to furnish the dimensions, size and shape of propeller, draught of water, consumption of fuel, power, and *speed* of the *Wizard.* He states that Mr. Smith and Mr. Wimshurst were on board, and proceeded with his boat from Deptford pier to Mr. Wimshurst's yard. But this stage, Mr. Editor, is not much broader than that of another Wizard, who performed in the Strand some short time since, as Deptford pier is on one side of the Thames, and Mr. W.'s yard just opposite!

If your numerous correspondents would contribute all they know with regard to the various propellers, patented and otherwise, it would be the quickest method of arriving at perfection; especially as many experiments are at present being tried on the river. I witnessed, only a few weeks back, the trial of a boat, built by Messrs. Penn and Son, fitted with stern propellers, which was progressing at a rapid rate; also another trial boat of Messrs. Ditchburn and Mare's, fitted with Beale's rotary engine, and Blaxland's propeller, which, I have since heard, is said to have reached a velocity of 10½ miles per hour through the water. I understand that in this boat of Messrs. Ditchburn and Mare's, all sorts of screws have been tried, and Blaxland's found to be the best; the boat having, it is stated, gone fastest with this propeller, and without any of that tremor at the after part of the vessel which is the general attendant of this species of propulsion. At the time I saw her she was not progressing at the above rate; but I was certainly struck with the compactness of the machinery, and the speed achieved, when the unfavourable lines of the boat (a man-of-war's pinnace) are taken into consideration. There are, again, other experiments being tried, and amongst them, those of the *Bee*, a small government steamer, on board of which Count de Rosen and his engineer, (another Swedish gentleman,) have fitted Ericsson's propeller, which, to my great surprise, has only reached a velocity of 4·5 miles per hour; when the same vessel, fitted with Smith's, gave an average, (see Appendix D to Tredgold,) of 6·8 miles; and with Blaxland's, 7·2 miles per hour. It was also stated to me, that the above velocity of 4·5 miles was accompanied by immense tremor of the vessel, which a facetious friend of mine not inaptly termed, "shaking her sides in derision of the scheme." Now, all this, Mr. Editor, is utterly at variance with the previously favourable performances of this propeller, as chronicled in *Mechanics' Magazine*, (see Nos. 721, 751, 781, &c., &c.) No account of the foregoing experiments have appeared in your valuable Miscellany, or, to my knowledge, any where else; and if any of your numerous readers can forward any particulars relative to the above trials, they will greatly assist the enquiry.

Before parting, Mr. Editor, I should wish to ask your valuable assistance, to put us right in regard to the many plans at present experimented upon. Church, Ericsson, Smith, Lowe, and Blaxland—each and all have patents for their different modes of propelling, and all seem to be quarrelling with each other as to the validity of their claims. Thus, Mr. Editor, Lowe claims segments of a screw in 1838; though Shorter, the man to whom Lowe was apprenticed, used the same in 1802; and patents were taken out for the same in 1829 and 1836. Then Church, in 1829, claimed blades or segments; and Ericsson, in 1836, claims the same; and not only have both of these been pronounced to be identical, but both were preceded by Brown, in 1825. Ericsson's, also, as at present fitted to the *Bee*, is at utter variance with his patent, his plan being Church's, which is one shaft working within the other, with a propeller on each. If you could extricate us in any way, Mr. Editor, from this chaos of claims—bringing to our aid your extensive practice in patent business, and knowledge of patent rights—you would be rendering nothing short of a great public service. To me the fairest mode of procedure appears to be, to award the palm to him who shall accomplish the most; and on this ground only can the many candidates rest their respective claims to pre-eminence, and the more substantial, though perhaps less flattering reward, *remuneration*. I earnestly hope, Sir, that you will set us right with

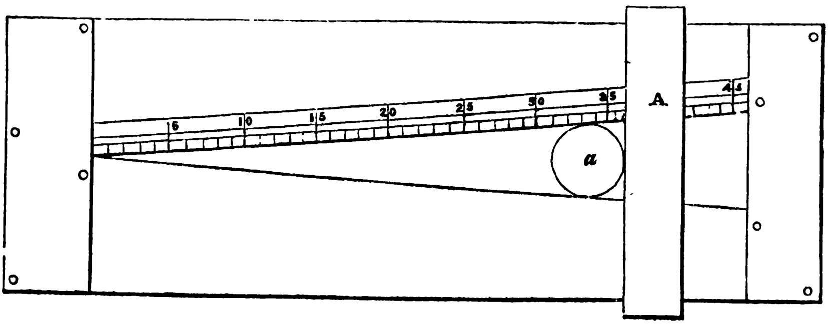
regard to the above claims—for I know that many clever men are at present deterred from entering upon this system of propelling, because they cannot see which course they should pursue, without entangling themselves in law proceedings, and, by screwing the water, have the cash screwed from their pockets into those of the gentlemen of the long robe. By complying with this request, you will still further attest your devotion to science, of which you have been the undaunted advocate, from the commencement of your valuable Journal. I have a strong impression that a fresh era has commenced, and that screw propelling is destined, ere long, to supersede the common wheel. I am, Sir, &c.,

STERNPOST.

[Our friend "Sternpost" would impose on us a very thankless task. The most we can venture to say, without embarking on "a sea of troubles," is, that though we do not think any existing patent for the mere use of the screw as an instrument of propulsion, (if there be any such,) could be sustained, there may have been new and useful modifications of it, for that purpose, patented, which the law will undoubtedly protect.—ED. M. M.]

IMPROVEMENTS IN WIRE GAUGES.

Fig. 1.



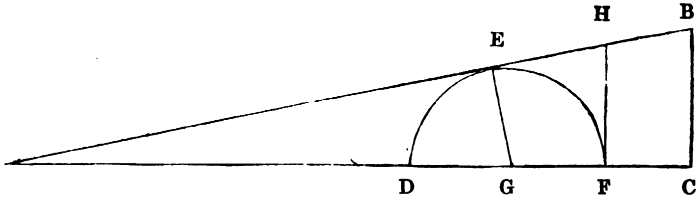
Sir,—At the time the communication of "K. H.," relative to an improved wire gauge, appeared in your pages, (last vol. p. 520,) I observed that the instrument proposed by him was liable to the objections stated by "R. H.," at p. 74 of your present volume; and a method by which those objections alluded to might be obviated presented itself to me. But being then otherwise occupied, and being, moreover, unaware of the importance to the arts of a measure of such extreme accuracy as that suggested by your correspondent, I thought no more upon the subject till the appearance of "R. H.'s" communication. From your insertion of the communication just referred to, I conclude that the accuracy of measurement to be attained by the use of "K. H.'s" instrument is desirable; and as, with perhaps a little pardonable vanity, I think my mode of obviating the defects of the instrument, as proposed by "K. H.," is somewhat simpler than that of "R. H," I am emboldened to ask you to lay my view of the matter before your readers.

Fig. 1 is the form of the instrument I propose. It will be seen that it is "K. H.'s" second form, with the addition of a sliding-piece A, and an alteration which is not so immediately obvious. This alteration is in the index, which I propose shall be so constructed that, when the cylinder *a*, whose diameter is to be measured, is introduced into the opening, and pushed as far as it will go towards the angular point, and the sliding piece A brought close up to it, the required diameter will be shown where the index is cut by the inner edge of the sliding piece.

The method of constructing the index so as to possess the required property is sufficiently simple, although the means by which we arrive at it may seem to some of your readers rather circuitous.

Let A B C, fig. 2, represent half the triangular opening of the instrument; that is, let A B be one of the *sides*, B C half the *base*, and A C, which we may

Fig. 2.



call the *axis*, a line drawn from the vertex to the middle of the base. Also, let D E F be half the cross section of the cylinder whose diameter is to be measured, having its centre in G, and touching A B in E. Draw the radius G E, and F H perpendicular to A C. Now, the problem is, to find the relation subsisting between G E and A H, or to find a value of A H in terms of G E, and the known quantities A B and B C.

The three triangles, A E G, A F H, A C B, are similar, having the angle at A common, and right angles at E, F, and C, respectively. Hence we have,

$$BC : AB :: GE : AG.$$

Therefore, by addition,

$$BC : AB+BC :: GE : AG+GE;$$

or, since $GE=GF$,

$$BC : AB+BC :: GE : AF \quad \ldots \ldots \quad (1.)$$

Again, $AC : CB :: AF : FH \quad \ldots \ldots \quad (2.)$

Also, $BC : BA :: FH : AH \quad \ldots \ldots \quad (3.)$

Hence, compounding the analogies (1), (2), and (3),

$$AC \cdot BC : (AB+BC)\,AB :: GE : AH.$$

$$\therefore\ AH = GE\frac{(AB+BC)AB}{AC \cdot BC} \quad \ldots \ldots \quad (4.)$$

If we now make G E, half the diameter, $= \frac{1}{2}d$,
A B, the side, ... $= s$,
B C, half the base, ... $= \frac{1}{2}b$,
and A C, the axis, ... $= a$,

the expression (4) becomes,

$$AH = d\frac{(s+\frac{1}{2}b)\,s}{a\,b} \quad \ldots \ldots \quad (5.)$$

That is, $\frac{(s+\frac{1}{2}b)\,s}{a\,b}$ will be a number, by which, if any diameter, within the compass of the instrument, be multiplied, the product will be the distance from A, measured towards B, of the point where, when a cylinder of that diameter is introduced, and pushed home by the sliding piece, the side will be cut by the inner edge of the sliding piece. It will be sufficient to find one point of the scale in this way. For since the value of the expression (5) varies directly as the diameter, the points corresponding to other diameters may be found by simple subdivision and repetition. Thus, if we first find the point corresponding to a diameter of $\frac{1}{2}$ inch, that corresponding to $\frac{1}{4}$ inch will be midway between this point and A; that corresponding to $\frac{3}{4}$ inch, will be as far beyond the point first found as the point corresponding to $\frac{1}{4}$ inch falls short of it. And so the scale may be filled up.

The foregoing investigation may be more generally available, if I put the formula in words, and give an example.

Add together the length of the side and half the base, and multiply the sum by the length of the side, for a dividend. Multiply together the length of the axis and the base for a division. Divide the first of these quantities by the second, and the quotient will be a number, by

which, if any given diameter be multiplied, the product, laid off from A towards B, will determine the point corresponding to that diameter.

Example.

Suppose the length of the side 3·5 inch, and the base ·5 inches. Then the axis will be

$$\sqrt{3{\cdot}5^2 - {\cdot}25^2} = \sqrt{12{\cdot}25 - {\cdot}0625} = \sqrt{12{\cdot}1875} = 3{\cdot}491.$$

For the dividend we shall have

$$(3{\cdot}5 + {\cdot}25) \times 3{\cdot}5 = 13{\cdot}125,$$

and for the divisor,

$$3{\cdot}491 \times {\cdot}5 = 1{\cdot}746. \quad \text{Therefore,}$$

$$13{\cdot}125 \div 1{\cdot}746 = 7{\cdot}517,$$

is the constant multiplier required, for an instrument of the above dimensions. Hence the point in the scale, corresponding to a diameter of $\frac{4}{10}$th inch, or ·4, for example, will be $\cdot 4 \times 7{\cdot}517 = 3{\cdot}007$ inches from A, and this point being laid down, and marked 40 for hundredths, the others may be found by subdivision.

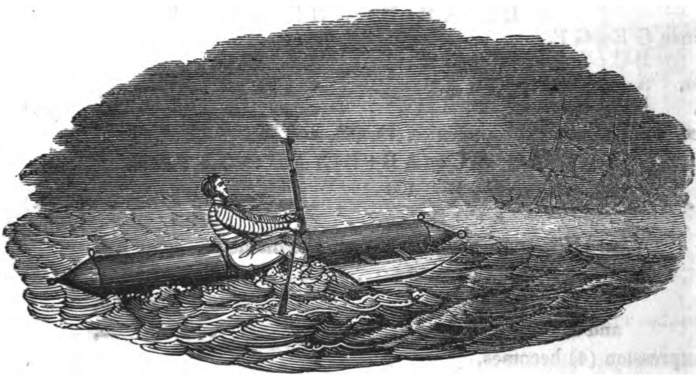
I am, Sir, yours respectfully,

G.

Hermes-street, Pentonville,
January 25, 1843.

CAPT. BEADON'S LIFE-BUOY IMPROVED.

[We are indebted to Captain Beadon for the following copy of a letter dated 23rd February last, addressed by him to the Secretary of the Society of Arts, and read at the next subsequent meeting of the Society.—Ed. *Mech. Mag.*]



Sir,—I beg to send an improved model of my Life-Buoy for the inspection of the Society. You will observe that it has the following different arrangements:—

Two oars are attached by universal joints at their ends. The light box has a spiral brass spring. Two man ropes are added.

By this novel application of the oar, it can be used in any seaway with ease; the person using it will face in the direction he is going, and he has his strength applied in the most advantageous manner. The brass spring presses the fuze-box closely into its cover, thereby preserving it from wet; affords facility to inspect it, and to attach the buoy to the stern; and when disengaged, gives elevation to the light by its expansion, and occupies less room when collapsed.

The "man ropes" will afford a person an easy and effectual means of securing himself from being washed off. Thus, if it be necessary to send a seaman to the surf with a line from a stranded ship, it will be next to impossible for him to be washed off, and if necessary, he can disengage himself in an instant without "untying;" these ropes are handy for securing another person whom he has picked up. It will be easily seen, that many modifications of this apparatus can be effected according to the purpose required. For instance, the oars can be secured by any seaman with rope. The eye-bolts in the extremities, formed of "thimbles," seized into a rope grummet passing round the buoy. There is nothing in the construction which ship's artificers cannot make on board. Other buoys with more outriggers, oars, seats, and of larger dimensions, and with shapes

better adapted for speed might be made, but having waded through most expensive experiments, I presume to say, no method of propelling for this purpose will improve upon the simplicity and effectiveness of the oar, thus arranged. It has been observed, that a man would be too exhausted to use the oar; my answer is, if he has strength to reach it he will have strength to ply it; many a hapless mariner has reached Cook's excellent invention, and clung to it for hours with inevitable death before him. Having had the misfortune, together with 17 others, to have been more than fourteen hours in the water, off the Island of Lintin, in China, during a tempestuous night and part of the following day, in April 1841, I will state for the benefit of others the good which results from exertion.

The vessel, a Chinese fast boat, foundered at her anchors during a heavy squall, and left us clinging to her starboard gunwhale, but wholly in the water; the oars, hatches, and different articles, kept floating up, and were driven against us with great violence, and were soon carried away by the tide, which was opposite to the direction of the wind. As the vessel became less buoyant every minute, and suspecting she would soon go down as the air escaped, I urged the men to assist me in providing for such an emergency by lashing with the boat's sheet all we could. I could not induce any of them, except Robert Smalls, ordinary, and Thomas Allen, boy, both of her Majesty's ship *Conway*, to do so. By great exertion we contrived to collect a considerable bundle, sufficiently large, as it eventually proved to support six of us, including four who could not swim, for many hours.

About daylight, the vessel's mast having taken the ground, she was swept for a time under water, when providentially, her ballast fell out and she floated bottom up. For a time all were swimming for their lives. Mr. Edward Turnour, of the *Conway*, approached us on the bundle, but at my request swam to the rudder, floating a long way off. I mention this noble act of obedience to show that it was not a lack of fortitude which overpowered the others, but a mistaken notion of saving their strength, as they answered my orders by entreating me not to "waste my strength so."

By the aid of a short plank used as a paddle, we rejoined our comrades on the junk's bottom on the turn tide, having been carried miles from them. In short, when picked up, all, save Smalls, Allen, and myself, were exhausted, and the remainder as helpless as infants from cold and cramp produced by inaction. For myself, except being hungry, I never felt better. A ray of hope stimulates to exertion, and God has beautifully adapted the frame of man for all emergencies, if we avail ourselves of those powers and means. Through the winter of 1842, I was in the habit of jumping into a canal with clothes on, and, from exerting myself in trying plans for propelling, I never took cold. I forgot to mention, that one poor fellow, James Shrowsbree, a stronger man than I, was washed off the boat's bottom, and drowned. In the late wrecks many lives would have been saved had the ships possessed a buoy of this kind, I have little doubt.

I am, Sir, your most obedient, &c.,

J. Beadon.

CLARK'S PYRO-HYDRO-PNEUMATIC APPARATUS.

A patent has been just granted to Mr. C. Clark,* for a pyro-hydro-pneumatic apparatus invented by him. We are enabled to mention that the most novel part thereof is a steam condenser, which acts without the aid of cold water, or the coiled or any other tubing hitherto used in the process of distillation. The vessel used by Mr. Clark is capable of receiving and condensing a certain quantity of steam as fast as it comes over out of the boiler, and to do so at an equal ratio, without interruption. The liquid obtained is of as low a temperature as any produced in the common way. It is well known that the steam of certain liquids, when reaching the still-head, (whence it is generally made to pass direct into the narrow coil pipe,) remains impregnated with a proportion of such elementary impurities contained in the steaming liquid, as are capable of being atomically volatilized by a boiling heat exceeding 212°. Whenever these generally heavy impurities convey a bad taste, the condenser, as well as some other vessels connected with it, have the effect

* 76, Cornhill.

of removing such taste, without destroying any of the purer liquid combined with such odorous effluvia, which, as it were, rise at the top of the steam. This condensing apparatus may be attached to any still; and, in addition to its utility on the large scale, it will prove a great convenience in all distillations on the small one, by rendering the aid of the cold water tub unnecessary, yet condensing with uniform regularity, and making it possible to purify or rectify the steam rising into the still-head, prior to its liquefaction by the condenser.

GAS-METERS.

Sir,—I am pleased to find in your Magazine for the past month an exposition of a ridiculous pamphlet on gas-meters, the farce lately enacted at the Adelaide Rooms, and the only correct report I can find of the lectures delivered at the Westminster Mechanics' Institution, by Mr. Wright, which I had the satisfaction of attending. I feel a desire to add, however, a few more remarks on the subject of gas-meters, which I shall be glad to see inserted in your next.

The comparative merits of the wet and dry meters have been so well described by Mr. Wright, at the conclusion of his lecture, (see p. 135,) that I need not refer to the principles of either; but I can state that I had one of the patent *dry* meters from Mr. Defries, in March last, which was connected to an experimental *wet* meter, carefully made by Mr. Smith, of Bridgewater-gardens. For the first three months, it registered full 10 per cent. faster than my experimental one. About the fourth month the sliding-valves became sticky, from a deposit in the chamber in which they slide, which only permitted the gas to pass by spurts; so that in the fifth month the meter required frequent agitation, to keep the light burning at all. This Mr. Defries attributed to some peculiar quality of the gas; but the same gas passed through nearly 300 of Mr. Smith's wet meters at the same time, and for several years before, with scarcely a single failure attributable to the make of either. I have now before me an account from a town near this place where there are some hundreds of wet meters in use; but seven dry meters have been lately put up for trial, two of which register plus, four minus, and one will not register at all. These certainly do not deserve the eulogiums which have been bestowed upon them by Messrs. Flower and Co.; but ought rather to be styled "dry meter fallacies." Mr. Jones is *reported* to have proved that water will accumulate in the wet meters, thereby raising the water line, and registering a greater quantity of gas than has passed through them; that he has tested many, and found them all false, and that they are erroneously constructed. If so, why has he not stated by whom they were made, so that the public might know who are the makers unworthy of confidence?

Now as to the accumulation of water by condensation, is it not contrary to scientific principles that it should do so? And certainly practice goes to prove that such statements are gross falsehoods, and appear truly ridiculous to every practical man. I have letters from the principal towns in Kent and Sussex, which prove that not a single case has occurred, where an accumulation has been found above the water line; but, on the contrary, it has been requisite to replenish water in from 5 to 20 per cent. of the number, every quarter. I have between 200 and 300 meters under my care, and I have not found more than one accumulate water, and in that case the old service-pipe was found to fall from the street main to the meter: I had a new one properly laid down, and I now have to replenish water in that, as in others, which I find to be about one in twelve. If common sense is applied while we think on the subject, with a very superficial knowledge of evaporation and condensation, we should be led to conclude that we might expect to find just that which practice proves to be requisite, and that it would be more or less, or none, according to the situation in which the meter may be placed as to temperature; for, although some of the portion vapourized flows back into the meter, much the greater part is converted into steam, and is driven off at the orifices of the burners. It is not uncommon for men to seek for some plausible reason to induce the public to give their articles a preference; and thus I account for the introduction of the "Patent Protector Gas-meter." But it appears this is not a new invention. It is a means by which water above the proper height will flow over. Mr. W. Wood, of 4, Hollen-street, Soho, says he has made them for the London Gas Company, as far back as 1838, and I have seen a similar contrivance—which any other person may see—at Mr. Smith's in Bridgewater Gardens, which he made three years ago (and will apply the same now to any one who may order it). But as it can never be of use except in the presence of an operator putting in water, it will only save the trouble of taking out two of the plugs, and stopping off the gas while the water is being put in. It may be that Mr. Flower had one of these *in his imagination*, with the offensively scented gas-water accumulating, and dripping from this syphon,

when he called the wet meter "*a drivelling idiot.*"

Mr. Hood, in the *Railway and Commercial Gazette*, of February 18, has imputed your notice of Mr. Botten's meters to interested motives. But the honourable distinction for impartiality which the *Mechanics' Magazine* has sustained for so many years, will induce others to attribute it to any other circumstance.

I cannot pass over the statements which have been made against gas companies, and their servants, without notice. They being charged with *imposture* and *trickery*, *sinister influence*, *&c.*, *&c.*, And although this has been noticed in your pages, I propose to offer other considerations of these aspersions. Let us suppose on the part of those who have to dispense gas the wish to defraud the consumers, would it be to their interest to employ a maker so dishonest as to make at their request a falsely registering meter? or a man who could not show that he knew how to make one that should be correct? And as all the parts are cut out with expensive punches, dies, &c., for expedition in the manufacture as well as correctness in all the parts, it is evident they would not have different sets of tools made to vary with the measure of the honest or dishonest wishes of their various customers. In the list of persons who cater for orders to make meters, some may, no doubt, be found who make a cheap inferior article, uncertain in their measurement, and such being offered to fitters with tempting discounts, many of such may find their way into use, although they, as Mr. Flower says, "have been sent to the works of the company and a permit obtained for their use," and "the measure of such meters neither just nor honest." Now as we did not learn who were the makers of those under examination at the Adelaide rooms, I am the more inclined to the above suspicions, and that such were selected.

Much has been said to persuade the public that the "Company's men" under the "sinister influence" of their employers are induced to act unfairly by putting too much water into the meters. But what director or superintendent of gas-works would be silly enough to advise any such dishonest trickery without seeing, that by so doing, they would lose all moral restraint over men so employed, and who, being dishonest to one party would be so to another, and open to temptation in every place to be guilty of tricks with the meters, whereby their employers would be defrauded?

The public may rest assured that it is the interest of the manufacturer to make for all alike a just measure. And that it is not a policy at all likely to be adopted by gas companies to teach their servants to be dishonest.

I am, Sir,
Yours respectfully,
SAMUEL BARTLETT.

Maidstone, March 6th, 1843.

[We do not think the incidental attack on the Botten meter, contained in this letter, does much credit to the candour of the writer. Why should the water become sooner fetid in a Botten meter than in any other? And why should other people be so eager to contest the patentee's title, if it were a thing of such little value, as alleged? The person of the name of "Hood," who appears to have been criticizing our labours in the obscure Gazette alluded to, is, we suppose, the same scribbling ironmonger, and near neighbour of Flower's, who, by virtue of his calling, fancies himself an oracle on all subjects which have any relation to iron, from coal-scuttles to chimney-cowls, (he knows what *ascension* is,) and whom Mr. C. W. Williams has made such wonderfully small meat of. When he can do any thing better than impute motives—which any malicious blockhead can do—it will then be time enough to care for what he says.—ED. M. M.]

MATHEMATICAL SYSTEM OF PUNCTUATION.

Sir,—In order to facilitate the progress of science, I conceive, a MATHEMATICAL system of punctuation, *in* SCIENTIFIC *treatises* of importance, is much to be desired. I still would divide works, into groups (or families) of words, as is at present done by books into chapters, and chapters into sections and paragraphs, &c.: but I would be more mathematical in the inferior groups including sentences and their members.

The most valuable quality of scientific verbal composition—as regards itself and not its subject—I hold to be that of forming a medium through which the objects of a writer's conceptions may be viewed, by persons educated in the same language, with the greatest freedom from distortion and ambiguity. Now all words in every verbal composition are related one to another, individually or collectively, in degrees varying as much as relations in human families; and consequently, owing to the limited supply of points, these degrees of relationship are but very inadequately expressed when silent

(written or printed) language is the medium employed for communication of thought: but in oral language this difficulty does not occur to the far-seeing and eloquent claimant of the attention of assemblages of rational beings;—that orator, who sees the connexions of the several parts of the events he narrates or of the scenes (or mechanical combinations) which he describes, expresses—by modulations of sounds, and durations of pauses, with an unlimited variety of minute shades of difference—relations of parts, in their several degrees, with a beauty and an accuracy towards which silent language, (except, perhaps, music,) notwithstanding the advance of sciences of which it is the disseminator, has, for centuries, made an approximation but the most trivial, and equally trivial has been the taxation on the reader for the supply of his previously-acquired notions of the necessity (or propriety) of the case. The rules for punctuating, given by our grammarians, I have, for many years, considered to be inadequate for the explanation of this branch of science. I know some persons are prejudiced against any increase to our number of points—Cobbett for instance: but I appeal to the candour of unprejudiced and mathematical minds; and I ask if they perceive not a variety, in the connexion of the parts of many a paragraph, which "short sentence" lovers, by their multiplicity of full points, very inadequately express.

There is one glaring instance of our poverty in means of punctuating which I will here mention. Within the compass of a sentence we have an ambiguous form of punctuation, which, from knowing the necessity (or propriety) of the case, the reader never misunderstands; but, for the same reason, neither would he misunderstand if there was no punctuation whatever;—I mean the punctuation of a series where an ellipsis occurs of the words "and," "or," &c. In this case there is the same punctuation used for the second term of a series as if it were merely explanatory of the first, and at the same time there is no advantage gained by this pointing except where several words are used for one term of the series: and as an advantage highly desirable I suggest the introduction of a new point to represent the conjunction which, though omitted, has to be implied in the manner of reading: and for this purpose I should propose a dot like a decimal point—that is like a full point raised, from the bottom, to line with the middle of the letters, or on the level with the hyphen;—and thus we should rescue the comma—and sometimes the full point—from an office inconsistent with its proper quality of a divider of the parts of a sentence; and the terms of a series, which are all in the same case, would be more properly distinguished by this new representative of the elliptical conjunction.

I would be glad to state more at length, in a future letter or letters, my reasons for conceiving that a more scientific system of punctuation is so desirable; but for the present I submit the following arrangement of points in the order of what I should assign to each for its respective power:—

1.	2.	4.	5.	8.		3.	6.	7.	9.
,	—	;	:	.	And in combination	,—	;—	:—	.—

Which arrangement—with powers proportional to their respective numbers as above, would stand, along with the compounded and single points now in use, thus:

Mathematical Arrangement.

1.	2.	3.	4.	5.	6.	7.	8.	9.
,	—	,—	;	:	;—	:—	.	.—

I feel persuaded there are many persons—even in the inferior classes of society—desirous, and anxiously so, for a system of a more definite nature—with more fixed rules—than any that has hitherto been submitted to their notice—for scientific treatises.

J. M. B.

Lancaster, January 11, 1843.

THE SUPPOSED ELECTRICITY OF STEAM.

A paper by Professor Faraday was read last week before the Royal Society, on the source of the electricity which recent observations have shown to accompany the issue of high pressure steam from a boiler. The experiments of the Professor lead to the conclusion, that the steam itself has nothing to do with the phenomenon. By means of a suitable apparatus, he found that electricity is never excited by the passage of pure steam, and is manifested only when water is at the same time present; and hence he concludes, that it is altogether the effect of the friction of globules of water against the sides of the opening, or against the substances opposed to its passage, as the water is rapidly moved onwards by the current of steam. Accordingly it was found to be increased in quan-

tity by increasing the pressure, and impelling force of the steam. The immediate effect of this friction was, in all cases, to render the steam or water positive, and the solids, of whatever nature they might be, negative. In certain circumstances, however, as when a wire is placed in the current of steam at some distance from the orifice whence it has issued, the solid exhibits the positive electricity already acquired by the steam, and of which it is then merely the recipient and the conductor. In like manner, the results may be greatly modified by the shape, the nature and the temperature of the passages through which the steam is forced. Heat, by preventing the condensation of the steam into water, likewise prevents the evolution of electricity, which again speedily appears by cooling the passages so as to restore the water which is necessary for the production of that effect. The phenomenon of the evolution of electricity in these circumstances is dependent also on the quality of the fluid in motion, more especially in relation to its conducting power. Water will not excite electricity unless it be pure; the addition of it to any soluble salt or acid, even in minute quantity, is sufficient to destroy this property. The addition of oil of turpentine, on the other hand, occasions the developement of electricity of an opposite kind to that which is excited by water; and this the author explains by the particles or minute globules of the water having each received a coating of oil, in the form of a thin film, so that the friction takes place only between that external film and the solids, along the surface of which the globules are carried. A similar, but a more permanent effect is produced by the presence of olive oil, which is not, like oil of turpentine, subject to rapid dissipation. Similar results were obtained when a stream of compressed air was substituted for steam in these experiments. When moisture was present, the solid exhibited negative, and the stream of air positive electricity; but when the air was perfectly dry, no electricity of any kind was apparent.

THE FOUR-WHEEL SYSTEM—NOTES ON MESSRS. BURY AND CO.'S CIRCULAR.

[The "Practical Engineer" has sent us the following "Notes" on the Circular of Messrs. Bury, Curtis, and Kennedy, published in No. 1006; and expresses a hope, in which we cordially join, that, though he does not see fit to subscribe his name, "such truth as there is in them, will not be thought the less deserving of attention." Another correspondent referring to Messrs. Bury and Co.'s protest against anonymous censors, observes—"I see just as little force in it as in their defence of the four-wheel system. Facts are facts, be the publisher of them who he may; and observations on facts can never so certainly pass for what they are exactly worth as when left to speak for themselves. If we may call 'a cat a cat,' will it be less a cat if we omit to add that the creature's name is Selina? Advertising a name and address may be of service to some people, and therefore they do well to advertise; but he does not less well, who, desiring that truth alone should prevail, rejects all such adventitious aids, as the accidents of name, or station? Besides, there is the guarantee of the Editor of a work like yours—who at least is well known—that he will not publish anything affecting any individual, or individuals, but what is of public interest, and communicated by parties, to give whom a public hearing —albeit 'with the vizor down'—may be of public benefit."—ED. M. M.]

NOTES, ETC.

The Circular put forth by Messrs. Bury, Curtis, and Kennedy, in the early part of last year, contains several misstatements with respect to the history of the introduction of the locomotive engine on the Liverpool and Manchester Railway, as also to other points, which, now that they have obtained the extensive circulation given to them by your pages, may, if not contradicted, pass with many persons for facts. I therefore propose to point out to your attention a few of these misstatements, and shall, for the purpose of readier reference, treat of the paragraphs of the Circular in the numerical order in which they appear in your Magazine.

Par. 1. "The Manchester and Liverpool Railway was the first that ventured upon the use of steam locomotive power, for the conveyance of passengers at a rapid rate, and the first engine made for that great and spirited undertaking, in 1828, had six wheels. This engine, however, failed to give satisfaction, and a premium of 500*l.* was, in the same year, offered by the directors for the best engine. After many trials the premium was awarded to a four-wheeled engine."

I conjecture that the "first" engine here alluded to was the *Twin Sisters*, made by Mr. Stephenson, but never accepted by the Company, principally, I believe, because it would not generate steam enough to move at the speed required, and *not* because it had six-wheels, or *outside* framing, as the framing was not of that kind.

Par. 2. "The four-wheeled engines of that day had all of them outside frames, and were used on the Liverpool and Manchester Rail-

road for four or five years, without other objections than the loss from the breakage of axles, arising from the defective plan of the frame, viz., in its being placed outside the wheels."

This paragraph is too much at variance with the facts of the case for me to characterize it. I shall, therefore, state what these facts are, and leave the public to judge for themselves. On reference to the 12th vol. of the *Mechanics' Magazine*, I find that the three engines which competed for the prize, namely the "Rocket," "Novelty," and "Sanspareil," had each of them *inside* framings. The following engines were the first employed on the Liverpool and Manchester Railway, after its opening: and all of them had *inside* framings, crank pins in the leading wheels, with four wheels each :—namely, the "Rocket," "Meteor," "Arrow," "Comet," "Dart," "North Star," "Northumbrian," and "Majestic."

Par. 3. "Experiments were subsequently made, intended to show that economy of fuel resulted from the use of a large fire-box; but the consequence was, that this part of the engine became so heavy as to require support behind it, and hence arose the re-introduction of a third pair of wheels, which had been previously abandoned as highly objectionable."

Owing to the frequent occurrence of accidents with, and the pitching and sinuous motion of the four-wheeled engines, it was resolved to try the effect of six-wheels, by putting an additional pair under two of the Company's old engines, namely, the "Atlas" and the "Mars." The additional wheels were put to the former at Liverpool, and to the latter in Manchester. These were the first engines with six wheels that were used on the Liverpool and Manchester Railway after its opening; and each of them had a *very* small firebox, compared to those now used in either four or six-wheeled engines.

The first engine on the Liverpool and Manchester Railway, having a large fire-box, was called the "Patentee;" and was originally constructed with six wheels; the driving wheels being without flanges.

The result of the experiment with six wheeled engines gave so much satisfaction, that, I believe, all of the Company's engines which were thought to be worth the expense were made into six-wheelers; and the engines which the Company are now making for that line are six-wheelers.

It is altogether erroneous, therefore, to say that the third pair of wheels was introduced on account of the use of large fire-boxes.

Par. 5. "It was the good fortune of the conductors of this foundry to originate the construction of four-wheeled engines, with inside framing, crank axles, and cylinders, placed in the smoke-box—all the practical and mechanical objections to the six-wheeled engines, and particularly with outside framing, having been foreseen at the earliest period. The first engine made upon this principle was manufactured in this foundry, in 1829, prior to the opening of the Liverpool and Manchester Railway. As the principle of the four-wheeled engine thus made gained publicity, great alterations have been introduced, from time to time, in ordinary six-wheeled engines, and at last we find, which we may be pardoned for adverting to with some satisfaction, that in the latest invention of an eminent engineer the outside framing is now being abandoned, or at least that the inside framing has been adopted in that instance, and the large fire-box dispensed with."

I am not prepared to say that Messrs. Bury and Co. were not the first who constructed engines of "four-wheels, with inside framing, crank axle, and cylinders placed in the smoke-box," considered as a combination of parts; but taking this statement in connexion with other parts of the Circular, it is calculated to produce a very false impression, and I have met with several persons who have been misled by it. I believe it was in a letter of one of your correspondents that I recently saw an acknowledgment of the *undisputed* title of Messrs. Bury and Co. to the introduction of the inside framing. Now where could such a notion be picked up but from their Circular? For every person at all acquainted with railways must know that outside framing is of comparatively recent date, long subsequent to Messrs. Bury and Co. becoming engine makers.

The reference made in the latter part of

this paragraph to the use of inside framing by an "eminent engineer," is one of the boldest things of the kind I ever saw. It can hardly be possible that persons engaged in the construction of locomotive engines so long and so extensively as Messrs. Bury and Co. have, can be ignorant of the fact that Mr. G. Stephenson made engines with inside framing more than 30 years ago. Even if they did not know that fact, can any body conceive it possible that they should so soon forget that the "Rocket," and many other engines subsequently made by Mr. R. Stephenson, for the Liverpool and Manchester Railway Company, had inside, and *not* outside framing? You will observe that it is not stated that that "eminent engineer" is *now* adopting the inside framing for the first time, but that the outside framing "is now being abandoned." The object of the authors of the paragraph is obvious enough.

Par. 11. "With the inside framing the centre line of the connecting rod is only 10 inches distant from the centre line of the frame, and the total distance between the bearings is 43½ inches; but where the framing is outside the wheels, these dimensions are necessarily 20 inches and 72 inches respectively, and the effects of the strain on the crank, in this case, would be, to its effect with the inside framing, as 14 is to 8."

We have here the *very remarkable* discovery announced, that the nearer the points of support are to each other, the steadier the superstructure; and Messrs. Bury and Co. prefer a base of 43½ inches to one of 72 inches! The statement of "the effects of the strain on the crank" is erroneous, as all six-wheeled engines are, I believe, provided with inside framing to resist the strain of the cylinders.

Par. 12. "For this reason, when the principal frame is placed outside the wheels, it becomes necessary to have an additional inside framing, to prevent the fracture of the axle. These additional inside frames not only cause an increase of friction on the bearings of the cranked axle, but also throw a considerable strain on the boiler, which then becomes the medium of connexion between the inside and outside frames, the inside frames being fixed at one end to the bottom of the smoke-box, and at the other end to the fire-box, while the principal frame is attached, by long brackets, to the body of the boiler."

This paragraph is strictly in keeping with the whole of the Circular. The framing, both outside and inside of the wheels, in the four and six-wheeled engine, is attached to the smoke-box and the fire-box, and also generally to the boiler. Messrs. Bury and Co.'s framing is, in my opinion, very defective in point of durability, and, as a mechanical arrangement, inferior to anything of the kind made by those persons who "are convinced that their plan was not perfect."

Par. 13. "The fact, that the use of four additional inside frames occasions six bearings on the axle, (that axle being only 6 feet long,) renders the system of principal outside framings so objectionable, that that circumstance alone should suffice to cause their rejection; for it is well known to practical men, that it is imposible to key so many bearings perfectly true, and to maintain them so, when the engine is working; and even if this precision were attained, the aggregate friction on the four inside, and the two outside bearings, would be much greater than when it is all thrown upon two bearings, because, in the first place, all the friction due to the weight of the boiler is borne by the two outside bearings alone, and that which results from the pressure of the steam, through the medium of the connecting rod, is thrown upon the four inside bearings; the pressure on the outside bearings is vertical, and the mean pressure on the inside bearings is nearly horizontal. So that, if instead of acting separately, these two amounts of pressure were thrown on the same bearings, the friction would only be due to the resultant of the pressures, and would, consequently, be much reduced."

This is a very uncandid paragraph — if not something worse. Messrs. Bury and Co. must be aware that not more than one, or two inside frames at the most, have been put into engines made within the last six years. I do not understand what can be meant by "it is well known to practical men that it is impossible to *key* so many bearings," &c. It is not usual to *key* bearings. Whatever may have been *intended*, this paragraph is not likely to deceive any one in the smallest degree acquainted with the subject.

Par. 15. "In engines with the bearings inside the wheels, the weight of the boiler has a

tendency to bend the axle down in the centre, while the pressure of the flange against the rail acts upon it in a contrary direction, and thus one strain counteracts the effect of the other. If the bearing is outside the wheel, the weight of the boiler tends to bend the axle upwards, and a strain on the flange of the wheel acting in the same direction and in addition to it; when the breakage of an axle takes place, these joint actions tend to force the wheels under the engine, and there being no flange on the outside of the wheel to prevent it, the engine is thrown off the rails, which, it is evident, cannot happen with an engine having inside framing, because the weight of the bearings presses the flange of the wheel against the rail, and assists the length of the journal in keeping it from falling or being thrown off the rails."

The introductory part of this paragraph is not disputed; but Messrs. Bury and Co., in adopting inside framing, did no more than copy Mr. Blenkinsop, Mr. Stephenson, and many others. As to the concluding part, Messrs. Bury and Co. may consult the Prussian journals of May last, and the evidence given at a late inquest on the London and Birmingham Railway.

Par. 16.—"Several instances have occurred on the London and Birmingham Railway, when an axle has broken, that not only have the wheels remained on the rails, but the driver has been able to proceed with the train to the nearest station."

This admission is more than might have been expected, seeing that Messrs. Bury and Co.'s engines are *perfect*.

Par. 20. "It is admitted that a locomotive engine should be as light as is consistent with great strength, simple in its construction, composed of as few parts as possible, and that the greatest regard should be had to the diminution of friction; it is thence obvious that four wheels must be preferable to six, provided they carry the engine with the same steadiness."

The proviso at the end of this paragraph is a very important one; but it is not secured in the four-wheeled engine: for if that has less friction than the six-wheeled engines, why do the engines on the London and Birmingham Railway consume more coke per carriage per mile than those on the Liverpool and Manchester Railway? Eighteen months or two years ago, the difference was rather more than two to one, and is still very considerable.

Par. 21. "The use of six wheels originated, (as we have before shown,) in the necessity of supporting the large and heavy fire-box, which was not sufficiently balanced by the smoke-box end; but no such necessity can exist in the locomotives made according to the accompanying plan, as the weight is nearly equally distributed on the front and hind wheels, and not only would two additional wheels be useless, but they would be prejudicial and dangerous when the engines are travelling upon curves."

This paragraph commences with a misstatement, which has been already noticed. The London and Brighton Railway Company can speak to the latter part, as a man from Messrs. Bury and Co.'s has been two or three months putting a third pair of wheels (which were sent from Liverpool) to each of the five or six engines made by the firm for that line; one of which engines, previous to the additional pair of wheels being put under it, caused a great loss of life not long ago.

Par. 22. "A four-wheeled engine travelling upon a curve is driven, by the direct application of the moving power, towards the outside of the curve; but, as the wheels are rather conical, the large diameter of the cone will ride on the outside rail, while the smaller diameter of the opposite wheel will bear on the inside rail, and this difference, (as the outside rail is longer than the inside one,) will allow the wheels to revolve without slipping or grinding."

Another notable discovery in mechanics! Hitherto it has been always understood that for the conical form of the wheels to produce the effect here described, the axles must be radii.

Par. 24. "The pressure against the outside rail, arising from this cause, will be in direct proportion to the distance between the front and hind axle of either engine, so that it will be as 10 to 6."

"Mechanicus," in the *Railway Times*, has shown the reverse to be the case. That the lateral motion of the four-wheeled engine will bend the rails, was shown by the accidents on the Eastern Counties, and the Paris and Versailles left bank railways, where the rails were bent in a straight part of the line. I believe no instance has been known of a six-wheeled engine bending rails.

Par. 26. "The friction arising from this

lateral motion further presses the engine against the outside rail. Thus the four-wheeled locomotive has, in proportion, a greater weight on the front wheels, it presses less against the outside rail, and offers much less friction when travelling on curves; hence, it has less tendency to be thrown off the rails, it is more simple in its construction, less expensive in repairs on account of this simplicity, and the smaller cost of it fully justifies the directors of the several railways who have given the preference to this description of engine."

It is notoriously untrue that the four-wheeled engine has less tendency to be thrown off the rails than the six-wheeled engine, as the Liverpool and Manchester, the London and Brighton, the Paris and Versailles left bank, and especially the Eastern Counties Railway, Companies can well attest. Messrs. Bury and Co.'s engines are by no means so simple as the modern six-wheeled engines, and cannot be kept in order at so small a cost. With reference to the original cost, if the statement of an Eastern Counties Director, in a letter published in the *Railway Times* about eighteen months back may, be depended upon, Messrs. Bury and Co.'s charge for a four-wheeled engine with an iron fire-box, (for I understand they will make no other,) was 50*l*. more than Messrs. Sharp, Roberts, and Co. then charged for a six-wheeled engine of the same size, with a copper fire-box. The North Midland Railway Company can give some information concerning iron fire boxes as they have had to put copper ones in lieu of the iron ones made by Messrs. Bury and Co.

Pars. 27 and 28. "At the time the above paper was read before the Society, the four-wheeled engine had but few supporters, arising, no doubt, from the erroneous supposition, that the safety of the engine was in proportion to the number of wheels used."

"It has, however, been steadily gaining ground in public estimation, and from the alterations going on in the construction of the six-wheeled engine, the advocates of them are evidently less confident in their superiority; and it is most gratifying to us that the advantages to be gained by the use of inside framing, which we then pointed out, are now tacitly admitted by our opponents of the greatest practical experience, who are gradually abandoning the outside frame."

Messrs. Bury and Co. acknowledge that the four-wheeled engine had but *few* supporters in March, 1840, but they say that since that time, "it has been steadily *gaining* ground;" they should have said, *losing* ground. The public, including nearly all the engineers of the day, many of whom are clear-sighted men on other subjects, are unable to see the merits of four-wheeled engines. The way in which Messrs. Bury and Co. here speak of inside framing, would lead persons unacquainted with the subject, to believe that the outside framing is falling into disuse, but this is by no means the case.

Par. 30. "Indisputable proof has been furnished, that an engine with *inside framing* cannot come down by the breakage of an axle: an engine, therefore, is equally safe on that plan of construction whether on four, six, or eight wheels."

Since the circular was published, three instances, at least, have occurred, of four-wheeled engines having come down after the breaking of the front axle, by which accidents taken collectively, it is believed more than one hundred lives have been sacrificed.

Par. 31. "The advantages of four-wheeled engines, on our plan of construction, we maintain to be the following:

"1st. The engine on four wheels is less costly than the one on six wheels; therefore, to have the same number of engines, or the same power, on a line of railway, much less outlay of capital is required."

The four-wheeled ought to be less costly than the six-wheeled engine, but hitherto, I believe, that has not been the case. An additional number of inferior engines, of equal nominal power will be required to compensate for the smaller power of each arising from that inferiority, as may be seen on the London and Birmingham, and Grand Junction Railways. The London and Birmingham Railway Company employ two engines to draw such trains as are drawn at full as high a speed by one engine on the Grand Junction Railway, although on the latter line the engines are what are now called small.

Par. 32. "2nd. It allows the engine to be got into less space, consequently, it is more compact, firmer, less likely to derangement, and much lighter."

The four-wheeled engine is on the contrary, generally six inches, and often nine inches *longer* than the six-wheeled engine.

Par. 33. "Though the engine is lighter the adhesion is more perfect from the weight on the driving wheels remaining nearly uniform, however unequal or out of level the rails may be; but in the engine with six wheels the adhesion is often imperfect, (arising from the impossibility of mathematical precision in maintaining rails on the level,) although there may be fully as much weight on the driving wheels generally; that is, the fore and hind wheels sometimes carry the greatest part of the engine. When the driving wheels get into an uneven part of the road, and the constant action of the power of the engine is not resisted by the adhesion at these points, the driving wheels revolve without properly advancing the train, as every observant traveller knows; and all weight carried beyond what is necessary for adhesion on the rails, is an unprofitable load. There is much less of this in the four-wheeled than the six-wheeled engine, seeing that there is only one pair of wheels used for adhesion, both in the four and six-wheeled engine, when used for passenger traffic; but as the four-wheeled engine is lighter than the six-wheeled engine, there is less power required to take it up the inclines, and therefore, more available power left applicable to the traction of the train."

The assumed superiority of four-wheeled engines would be more readily believed by railway proprietors, if Messrs. Bury and Co. could convince them that a greater amount of traffic can be done with the same number of four-wheeled engines, and weight of fuel than can be done with six-wheeled engines.

Par. 34. "4th. The engine is safer, as it adapts itself better to the rails, not being so likely to run off the line at curves or crossings."

"At *curves* or *crossings*,"—but what of the *straight* parts? The greater liability of four-wheeled engines to run off the line in *straight* parts, is a fact incontrovertibly established by the experience of the Eastern Counties, the London and Brighton, and the Paris and Versailles railways.

Par. 35. "5th. It is more economical in the working, requiring less fuel, there being also a less amount of depreciation, as there are fewer parts in motion, consequently less friction, or wear and tear, and fewer parts to maintain; and even those are more easily got at, therefore, much less expense is incurred in those repairs, which are common to both plans."

Every point in this paragraph is just the reverse of the truth.

Par. 36. "6th. The buildings, turn-tables, lathes, drills, smithies, and other costly conveniences necessary for the maintenance and repair of the engines, are not required on so large and extensive a scale, as the engine on four wheels is less in size than the one on six wheels."

The whole of this is at variance with facts, except so much as refers to the size of the turn-tables.

Par. 37. "7th. As the engine is more simple in its form and parts, there are fewer chances of delays, stoppages, and disappointments during the journeys, or the times of taking the trains."

Whatever the "chances" may be, what are the facts? Not only have the greater number of accidents happened with four-wheeled engines, but those accidents have been among the most disastrous that have occurred.

Par. 38. "In justice to ourselves we have thought it right to lay these remarks before the public, at the same time, that we are quite ready to construct engines upon six, or any other number of wheels, freeing ourselves from the responsibility of the consequence of any other plan than our own; and only requesting that such of our friends and the public as may entrust their orders to us will permit us, at least for the safety of travellers, and our own credit, to adhere to inside framing."

It appears from this, that the four-wheeled engine "has been steadily gaining ground" until Messrs. Bury and Co. have discovered that it would be more profitable to make six-wheeled engines than—to close their works.

February 2nd, 1843.

ATLANTIC STEAM NAVIGATION—THE GREAT WESTERN AND GREAT BRITAIN.

The annual meeting of the Great Western Steam Ship Company took place at Bristol, on Friday, the 3rd inst. The Report of the Directors stated, that the Directors regretted that, as on the last occasion, they again had to state a falling off in the receipts of the Company, those in 1841 having been 33,763*l.* 5*s.* 10*d.*, while those for 1842 were only 30,830*l.* 8*s.* 2*d.* Although the stagnation of trade arising out of the circum-

stances of the times in both England and America had pressed most severely on them, yet the falling off was mainly to be attributed to reports arising out of the peculiar condition of the company, and the industrious circulation of the same by competing interests, both here and on the other side of the Atlantic. The expenditure in the year 1841 had been 30,649*l.* 10*s.* 2*d.*, while in 1842 it had been reduced to 28,615*l.* 7*s.* 1*d.*, which included the costs of recoppering and thoroughly repairing their ship the *Great Western*, which had maintained the high character she had earned by the precision and unequalled rapidity of her voyages. The average outwards had been 14½ days, home 12½ days. The insurance on bullion sent out by the *Great Western* was effected at from 15*s.* to 20*s.*, while that by other conveyances at the same period was done at 30*s.* to 40*s.*; a proof of confidence in the ship. The experience of the last season had proved that the interests of the company were served by sailing the ship to and from Liverpool. The *Great Britain* is in a very forward state. The frame and hull are complete. The whole of the upper-decks, as well as the decks of the forecastle, forecabins, and aftercabins, are laid and caulked; nearly the whole of the state rooms, and other joiner's work, is finished. The forehold, afterhold, and iron coal decks before the boilers and abaft the engines are nearly finished. The boilers and funnel are fixed in their places, as are the cylinders, condensers, air-pumps, and other weighty parts of the engines. To add to her strength and diminish the apprehension of fire, the decks and partitions of the body of the ship occupied by the engines, &c., will be fitted up in iron. Nearly all the masts and spars are made, and should nothing unforeseen arise, she may be floated out within three months. The balance of the year's work, after carrying 430*l.* 13*s.* in reduction of the expenses incurred in the formation of the company, and of the loss on the first voyage, and also inclusive of interest on the reserved fund, is 1,784*l.* 8*s.* 1*d.* *The cash account showed the profits on the voyages already taken* (27 in number) *to have been* 25,971*l.* 15*s.* 10*d.* The cost of the *Great Western* was 61,671*l.* 15*s.* 10*d.*; the ship and cabin stores, &c., 1,081*l.* 19*s.*; the Company's building establishment cost 50,839*l.* 18*s.* 9*d.* The cost of the *Great Britain* has been to this time 73,908*l.* 0*s.* 4*d.* Mr. Guppy entered into a detailed statement, showing that the *Great Western* had herself yielded a good profit. Mr. Guppy also stated, that the *Great Britain* would be ready to be floated out in less than three months, and might be at sea within six months. He augured the most favourable results to the company from her completion, as from the large number of passengers she would be able to carry, she could take them on terms which would enable this Company to compete with the liners. He also calculated that in speed she would exceed any vessel yet afloat, while she could be sailed at an expense very little exceeding that of the *Great Western*.

ATLANTIC STEAM NAVIGATION.

Sir,—In your notice, last week, of the "Artizan, a new Monthly Journal of the Operative Arts," you say, "'Dr. Lardner and Atlantic Steam Voyaging' is an able review of the progress of Atlantic steaming during the last eight years, but ending in the very questionable conclusion, that, because it has hitherto been attended with loss, it must ever continue to be so." Now, Sir, I have read the article you allude to, carefully, and can find no such conclusion. The last paragraph of the article is as follows:—

> "Such, then, is our recipe for making Atlantic steam voyaging accomplishable with safety, regularity, and profit. Amid the apathy of some, and the perversity of others, it will of course remain untried; but we are thoroughly convinced of its virtue, as well as of its ultimate adoption; and we merely record it here, in order to bequeath it to a wiser and less untractable generation."

It may be objected, perhaps, that this prediction relates merely to a communication that is not *direct*. And so it does. But in speaking of the obstructions to a direct communication, with profit, the writer says that, *up to the present time*, they have proved insuperable. The doctrine, indeed, which you charge upon the writer of this article is not only unprofessed by him, but is such as no reasonable being could entertain for a moment. No man can say that it is impossible fuel may not be so economized, as to make Atlantic voyaging some day profitable; and no one can say that Atlantic voyaging may not be hereafter accomplished by the aid of machinery, operating without any fuel at all. But what can such hypothetical anticipations have to do with the feasibility of existing projects? The *Artizan*, I find, only says, that Atlantic steam voyaging is not capable of being prosecuted beneficially *in the present state of the art;* and when a new state of the art arises, we shall then be justified in founding estimates upon it.

Trusting to your sense of justice to insert this,

I remain, Sir, your obedient servant,

R. PHILLIPS.

Poplar, March 3, 1843.

[We would not willingly put an erroneous construction on the arguments of any one,

far less those of a new and meritorious competitor for public favour; neither do we think we have done so in the present instance. The paragraph quoted by our correspondent, instead of refuting, completely confirms what we said. The writer, after stating all the objections to *direct* Atlantic steam navigation, as it is now carried on, had concluded with recommending that it should be altogether abandoned for the *roundabout* passage, by Fayal. And he here sums up with saying—"Such is *our* recipe for making Atlantic steam voyaging accomplishable with safety, regularity, and profit. * * * We are thoroughly convinced of its *virtue*, as well as *ultimate adoption.*" No hope does *he* hold out of the objections to the direct passage being overcome by greater economy in the use of steam or fuel; *his* only hope of good rests on its entire abandonment. While on this subject, we beg to refer to the account, which will be found in the preceding article, of the proceedings at the last meeting of the Great Western Company, from which it will be seen that the *Great Western* has, after all, not been the losing concern supposed.—Ed. M. M.]

THE PORTLAND BREAKWATER.

A few years ago, convinced from the statements which we then saw, of the great national advantages which would result from the construction of a Breakwater at Portland, we devoted many columns of our journal to extending the publicity of the plan which had then been brought forward for securing the execution of this important and desirable work, and to promulgating the arguments which had been urged in its favour. It seeming, however, that there was little or no hope of engaging the favourable attention of government to the construction of the projected Breakwater, we ceased to bring the matter before the public notice. But it now appears that the subject is revived, and that a Committee of the House of Commons has been appointed to investigate and report upon it. We therefore willingly resume the important question, in the hope that we may, in some small measure, be instrumental in creating such a manifestation of public opinion as may have a salutary influence on those with whom the final decision of the matter rests.

We consider that we cannot more effectually serve the cause before us than by reproducing the following extracts from papers written on the subject of the Breakwater by the Messrs. Harvey of Weymouth, who have devoted years of most strenuous exertion to secure the accomplishment of this work, and who have applied themselves with great intelligence and industry to demonstrate the expediency and practicability of the plan.

Before giving the extracts to which we allude, we would take leave to observe that the perusal of the various papers which have been written on this interesting subject has entirely satisfied us of the very great importance of the proposed work—an importance which, we conceive, is daily being increased by the progress of the works at St. Malo. With a formidable naval port at this place, and one of still greater magnitude and strength at Cherbourg, the French, should we unhappily be involved in war with that nation, would possess the means not only of harassing our commerce, but of devastating our coasts, which we should be comparatively ill prepared to meet, seeing that we have at present no place of shelter for ships of war between Portsmouth and Plymouth. The construction of a harbour at Portland would effectually remedy this deficiency, for, in the first place, being distant only 22 leagues from Cherbourg, a squadron stationed at the former place could always watch the French port, whilst vessels from Plymouth and Portsmouth might rendezvous there in readiness to act either against Cherbourg or the more westerly ports of the French coast. Portland, also, being the point of the English coast nearest to the Channel Islands, the conversion of the Portland roads into a naval station would greatly add to the security of these islands—a circumstance which naturally lends us an additional motive for advocating the construction of the work. But we will not look at the proposed Breakwater merely with a view to its utility as an instrument of warfare. We contemplate it with more complacency and interest as the means of protecting commerce, and preserving life. We believe it to be a well-established fact, that had the Portland roads presented that refuge which it is now sought to create there, a large number of valuable ships and lives, which have been lost in that and other parts of the Channel, would have been saved. Considerations, therefore, of humanity and interest alike present themselves in favour of the proposed measure, and these, taken in conjunction with those to which we have before alluded as connected with the contingency of war, will, we trust, ensure an early commencement of the contemplated work.—*From the Guernsey Star*, —which then proceeds to give extracts from

the excellent papers of the Messrs. Harvey; but for these the reader may refer to our own volumes, [vol. xiv. p. 247, and vol. xv. p. 274], where they are given at length. The question of the construction of this Breakwater has always appeared to us but one of *time;* we hope that time has now arrived.

SOLID AND HOLLOW AXLES.

A paper, by Mr. J. O. York, who has a patent for hollow axles, was read at a late meeting of the Institution of Civil Engineers, giving an account of some experiments which he has made for the purpose of testing their strength as compared with solid axles. The paper described the common causes of fracture, attributing it to the concussion and vibration produced by various circumstances, such as a bad state of the line, the sudden opposition of any obstacle on the rail, or the shocks arising from the wheels striking upon the blocks or the chairs when thrown off the line. These shocks, which it was impossible to calculate the extent of, it was contended should be provided for by axles which would bear a series of heavy blows without fracture. The force of vibration, and its tendency to produce fracture in rigid bodies, was then treated of, with its effect in destroying the most fibrous texture of iron where elasticity was prevented, as is the case with railway axles, comparing the action with that upon the axles of ordinary road carriages, where the concussion was reduced by an elastic medium, such as the wood spokes of the wheels, which were bad conductors of vibration. By calculation it was shown that the twisting strain arising from the curves of the railway was of too small an amount to be considered as a cause of destruction to the wheels or axles even on lines with curves of short radii; and it was submitted that the requisite qualities in railway axles were—first, the greatest possible degree of rigidity between the wheels to prevent the axle from bending or breaking from concussion; and, secondly, the greatest quantity of elasticity and freedom in the particles of iron within the axle itself to prevent the injurious effects of vibration. It was contended that the hollow axle was better able to resist these strains than a solid one, because the comparative strengths of axles are as the cubes of their diameters, and their comparative weight only as their squares; consequently with less weight in the hollow axle there must be an increase of strength, and also that the vibration had a free circulation through the whole length of the hollow axle, no part being subject to an unequal shock from the vibration, and that the axle would therefore receive less injury from this cause than a solid one.

A long series of experiments which had been made in the presence of Major-General Pasley and numerous engineers was then read, and showed results confirmatory of the position assumed by the author of the paper. In the discussion which ensued it was allowed that theoretically the hollow axles must be stronger than the solid ones, inasmuch as the same weight of metal was better distributed, and the practical experiments fully bore out the theory. Some curious specimens of solid axles which had borne a great number of blows before breaking, were exhibited by the Patent Axle Company, from Wednesbury. The quality of the iron was excellent, and had the same material been manufactured into hollow axles, it was agreed that many of the melancholy accidents upon railways would not have occurred.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM 22ND JANUARY TO 22ND FEBRUARY.

George Benjamin Thorneycroft, of Wolverhampton, iron master, improvements in furnaces used for the manufacture of iron, and in the mode of manufacturing iron. Sealed February 1, 1843.

James Boydell, Junior, of Oak Farm Works, near Dudley, in the County of Stafford, iron master, improvements in the manufacture of metals for edge tools. February 1, 1843.

James Clark, Power-loom cloth manufacturer in Glasgow, in that part of Great Britain called Scotland, an improved mode of manufacturing certain descriptions of cloths. February 2, 1843.

Taverner John Miller, of Millbank-street, Westminster, oil merchant, improvements in apparatus for supporting a person in bed or when reclining. February 13, 1843.

Samuel Kirk, of Stalybridge, in the County of Lancaster, cotton spinner, certain improvements in machinery or apparatus for preparing cotton, and other fibrous substances for spinning. February 13, 1843.

Charles Thatcher, of Midsomer Norton, in the County of Somerset, brewer, and Thomas Thatcher, of Kilmersdon in the said county, builder, certain improvements in drags or breaks to be applied to the wheels of carriages generally. February 22, 1843.

NOTES AND NOTICES.

Consumption of Smoke in Steam Vessels.—On Saturday last, a number of gentlemen—(amongst whom we observed Mr. M'Connell and Mr. D. Chapman, of Messrs. Thomson and M'Connell, Mr. John Alston, Mr. John Napier, Mr. Alexander Laird, jun., Captain Boyd of the Admiral steamship, Captain M'Keller of the *Fire King*, Mr. Robert Lamond of the Iron Company's steamers, Mr. Anderson, &c. &c.,)—took a trip down the river in the *Shandon* steamer, Capt. M'Lean, belonging to Messrs. Thomson and M'Connell, to which vessel Mr. C. W. Williams's patent argand furnaces, for the consumption of smoke, had just been applied

by Mr. William Butler, engineer. The trial was altogether a most successful one, and the absence of smoke complete. At starting, the patent apparatus was set to work. There being plenty of steam, the engine worked up to its full speed without smoke, while at the same time there was a decided saving of fuel. After a considerable run, and just previous to feeding the fires with fresh coals, the patent argand furnaces were altered to the common furnaces, by closing the air-ports of the patent apparatus. Instantly a dense smoke, as of old, rose from the chimney. To prove the perfect efficacy and facility with which the matter could be managed, the air-ports were again opened, and the smoke, in the course of five seconds, again disappeared. This was repeated again and again; and it was also manifest to all present, that more steam was generated on the new than on the old principle, with less consumption of fuel. besides the grand desideratum of *no smoke!*—The remainder of the trip to Greenock and Helensburgh was, after these trials, performed without smoke, there being always a sufficiency of steam. Amongst other favourable testimonials, it was stated by Mr. Chapman, that on the 11th current, in a trip from Glasgow to Helensburgh and back, the *Shandon* had saved *twelve hundred weight* of coals by the use of the patent furnaces. Much praise is due to the head engineers of the *Shandon* and *Admiral* steam-vessels, for their systematic method of proving the merits of the *Shandon* furnaces. We trust Mr. Alston will not cease in his endeavours, until smoke is banished both from the face of the land and the waters. Since the above was written, we understand that Mr. Butler (who is most perfectly versant in the art of smoke prevention,) has received an order to fit up the fine steam-ship, the *Admiral*, belonging to Messrs. Thomson and M'Connell, with the patent argand furnaces.—*Glasgow Constitutional of February* 22, 1843.

An Old Printing Office.—The printing office established by Christopher Plantin, about the year 1550, at Antwerp, then a great commercial emporium, has survived to our time in active operation, through the descendants of his daughter, the wife of John Moret, whose name the press has continued to bear. Perhaps no other avocation presents an equally unbroken descent. The Polyglott Bible of 1569—1578 is an enduring monument of Plantin's press, of which some of the productions attest the existence in 1553.

Constitution of the Atmosphere.—Mr. Stass, professor of chemistry, of the Polytechnic School at Brussels, has been making an extended series of experiments upon the constitution of the atmosphere from which it results, that the air is of the same constituent elements at Brussels, Paris, Geneva, and Copenhagen; but that sudden variations of its composition manifest themselves without any, as yet known cause. At twelve different periods he found in 1,000 parts of air by weight from 230·4 to 230·8 parts of oxygen; while on two others, the quantity of oxygen was increased to 231·1 and 231·4.

Indiscriminate Vision.—The celebrated optician Mr. Troughton, informed Sir John Herschell, (Phil. Mag. No. 143,) that he could not distinguish the several sorts of a regiment of soldiers from the green turf on which they were drawn up, nor ripe cherries from the leaves of the tree which bore them. His eyes, however, were perfectly sensible to rays of every refrangibility *as light*, but the spectrum afforded him only the sensation of two colours which he termed blue and yellow; pure red and pure yellow rays exciting in his mind the same sensation.

Berlin patterns, although a production of recent date, have become an article of considerable commerce in Germany, where a large amount of capital is employed in their manufacture. About the year 1805, a Mr. Phillipson published some patterns, which, being badly executed and devoid of taste, did not meet with the encouragement he expected. In 1810, Madame Wittich,—a lady of great taste and an accomplished needlewoman, justly appreciating the advantages the art would derive from such designs, and anxious that this species of amusement for ladies should be more widely spread,—prevailed upon her husband, a printseller of note at Berlin, to undertake the publication of a series of these patterns; which he did, got up in so superior a manner, that many of the first patterns which were issued from his establishment are now in as much demand as those more recently published: in fact, we very much doubt whether any, since published by other houses, have ever equalled, either in design or colouring, the earlier productions of Mr. Wittich. The designer and engraver of these patterns are of course paid as *artists*, in proportion to their talents; the cost of the first coloured design on point paper varying from three to thirty or forty guineas, but in some instances, as in the large pattern of Bolton Abbey, the Garden of Boccaccio, &c., it is considerably more. The colouring affords employment for men, women, and children; a dozen or half-dozen copies are given to each person at a time, with the original design as a guide. An industrious man seldom earns more than one thaler, or three shillings per day; the children from six to eight silber-groschen, or from sixpence to tenpence English. From the great increase of the trade of late years, and the number of new houses that have sprung up, it is impossible to give (as a statistical fact) any idea of the number of persons employed in their manufacture. Besides the hands engaged in the preparation of these patterns, they have been the means indirectly of affording employment to numerous other persons, by creating a demand for new and various articles in other branches of trade; such as in the preparation and dyeing of wools and silks, the weaving of canvas, &c., whilst others, principally females, are engaged in working the designs.—*Miss Lambert's Hand-book of Needlework.*

Sugar boiling.—R. H. Haynas, Esq., a practical planter of Antigua, well known for his successful experiments in sugar boiling, has put forth a prospectus of a work, which he offers to the acceptance of his brother planters, as the result of 30 years' experience. "This work contains an account of his method not only of improving the quality, but of increasing the quantity of *saccharine matter* in the cane at least 50 per cent, by an improved plan of cultivation, and management of the plant in all its stages, backed by arithmetical proof, that it is less expensive than that which is now in use in most of the islands: and that the results of its general adoption throughout the free colonies, would be a saving of 700,000 dollars in labour, and an addition of 50,000 tons of sugar per annum to the average exportations."—*Antigua Herald.*

The Grand Magnetic Machine at the Polytechnic Institution, consists of ten magnets placed in juxtaposition, having a combined weight of 156 lbs.; in connexion with which are two inductors, encircled by insulated copper wire 1-28th of an inch in diameter. On motion being given to these inductors by means of a treadle, causing them to revolve at a rapid rate, and coming alternately within striking distance of the two poles of the magnets, the points are brought in contact with a small cup of mercury, when beautiful azure sparks are emitted, which are sufficiently powerful to ignite spirits of ether, &c.—*Illustrated Polytechnic Review.*

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JAMES'S WEIGHING MACHINES.

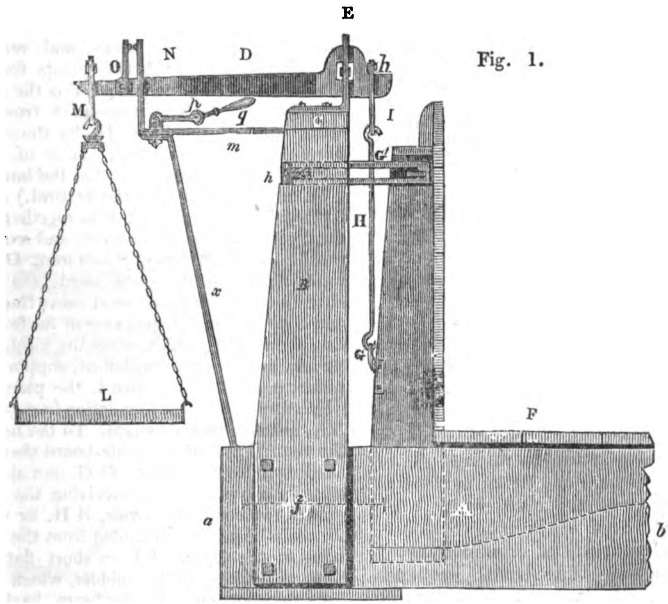
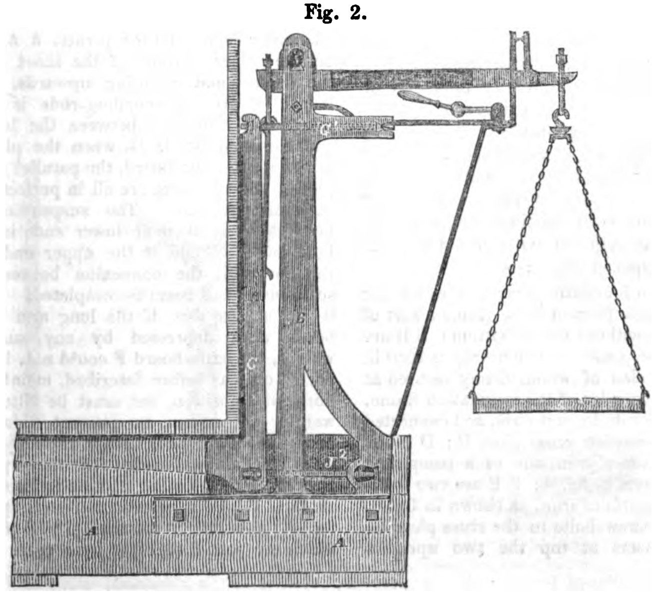


Fig. 1.

Fig. 2.



MR. HERBERT JAMES'S WEIGHING MACHINES.

[Patent dated September 8, 1842; Specification enrolled February 8, 1843.]

The improvements which form the subject of this patent relate principally to those larger contrivances for weighing, which are known in business by the name of *machines*, in contradistinction to common scales, to which the term *instruments* is popularly considered to be more properly applicable. And, the points in which Mr. James's machines differ most from those of this class previously before the public are these—*First*, the exactness with which, by means of an ingenious application of the parallel motion principle, the parts are adjusted and balanced—an exactness so great, that, in the weighing of tons, the addition of a farthing's weight is sensibly indicated, while at the same time no particular skill or care is required to obtain that exactness, and the structure of the machines is of so plain and durable a sort, that they will bear, without injury, the roughest usage; and, *second*, that instead of the scale-boards resting on, or being placed *above* the beam, as is usual with machines of this class, which is always a source of much inconvenience, and not unfrequently of great inaccuracy of performance, Mr. James suspends them *from*, or places them *under* the beam—except in one case only, that of hoisting and weighing goods at one and the same time, (a very clever machine for which purpose is among the varieties specified,) where, from the necessity of the case, the goods are uppermost.

Fig. 1 of the accompanying drawings is an elevation of a machine embracing these improvements, in their simplest form, and adapted to the weighing of goods by means of shifting weights. The following description we quote from the inventor's specification:—

"A A is a foundation frame of wood, the part of which from *a* to *b* forms a sort of oblong box, without top or bottom; B B are two uprights, (one of which only is seen in the figure,) also of wood, firmly secured at bottom to the sides of the foundation frame, A A, by screw-bolts and nuts, and connected at top by a wooden cross piece C; D is the beam, which is of iron, and of a compound form, as shown in fig. 4; E E are two fork-shaped supports of iron, as shown in fig. 5, secured by screw-bolts to the cross piece C, which connects at top the two uprights B B. The two arms of the beam are dropped into the forks of the supports E E, and suspended there by means of two triangular steel bits or pivots, which rest in the grooves of two steel sockets, which are inserted between the forks, and rest on the shoulders *e e*, the two pivots forming the fulcra of the machine. F is the goods scale-board, which is suspended from the short ends of the beam D, by the means presently to be described. It is of an L shape, (with the exception that the horizontal arms are longer than the vertical,) and is formed by connecting timbers together, and then planking the whole over, and securing the planks by transverse strips of iron. During the oscillation of the scale-boards, the horizontal arms of the frame-work move freely up and down within the open area of the foundation frame A A, which, when the machine is struck, as afterwards explained, supports the platform of the scale-board, the planks of which do not enter the foundation frame-work A A, but rest upon its edges. To the back of the vertical arm of this scale-board there are fixed two iron holdfasts, G G, one at each side, for the purpose of receiving the lower ends of two connecting-rods, H H, by which the scale-board is suspended from the short arms of the lever. I I are short flat iron bars, with slots in the middle, which hang from the short ends of the beam, having at the top of the slots grooved steel pieces inserted, by means of which they ride on triangular steel bits or pivots, *h h*, fixed on the upper surface of the short end of the beam, and pointing upwards. The length of the suspending-rods is determined by the distance between the bars I I and the holdfasts H H, when the platform of the goods scale-board, the parallel motion pieces, and the beam are all in perfectly horizontal positions. The suspending-rods being hooked at their lower ends into the holdfasts G G, and at the upper ends into the bars I I, the connexion between the scale-board and beam is completed. But as it is obvious that, if the long arm of the beam were depressed by any sufficient weight, the scale-board F could not, if connected only as before described, maintain its horizontal position, but must be tilted upwards, in order to prevent this, and keep the scale-boards always perfectly level, it is further connected to the uprights B B by four parallel motion pieces, two at top, G^1 G^1, (represented separately in fig. 6,) and two at bottom, J^2 J^2 (fig. 7), which are joined together by a cross piece,

which parallel motion pieces are linked to 8 holdfasts (see fig. 8) *k*, four fixed on the upright B B, and four fixed to the vertical arm of the scale-board. Each parallel

Fig. 3.

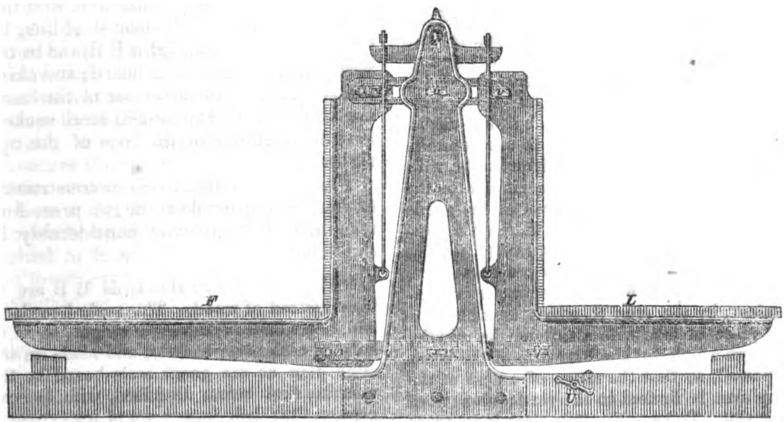


Fig. 4.

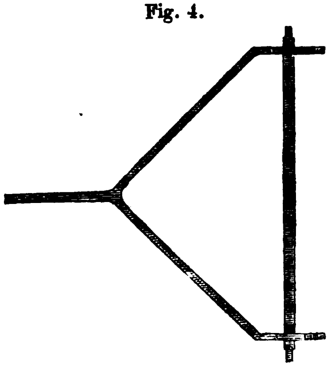


Fig. 5.

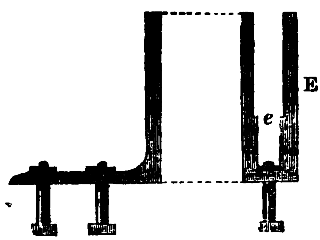
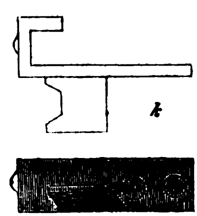


Fig. 6.

Fig. 7.

Fig. 8.



motion piece rides on knife edges in the holdfasts; but in the case of the upper parallel motion pieces, the knife edges point outwards, and the parallel motion pieces pull against them, while in the case of the lower, the knife edges point inwards, and the parallel motion pieces are thrust against them. L is the smaller scale-board for holding the weights. It is suspended from the long end of the beam by four chains which are connected at top to one common hook, which takes into a flat-iron bar M, with a slot in the middle, precisely similar to the bars I I, employed in the case of the goods scale-board, and riding like them on an upright triangular steel bit or pivot (*l*, fig. 3). The long arm of the beam is prevented having more play than would be proper or convenient, by the stop N, which consists of a flat piece of iron with a slot in the middle, through which slot the long arm of the beam is passed, so that the range of action of the long arm is limited to the vertical length of that slot. To keep the stop piece in its place it is connected by a horizontal stay *m* to the cross piece C, which unites the two uprights B B, and by an angular prop *x*, to the foundation frame A A. O, figure 1, is a short upright attached to the long arm of the beam in front of the stop N, with a small pointer, or indicator, at top, and when this pointer is exactly opposite a similar pointer which projects from the top of the stop N, the weights are in perfect equipoise. *p* is what is called a strike, consisting of a small roller *p*, with a handle *q*, which roller is connected to a cross pin passed through the cheeks of a stud secured to the top of the horizontal stay *m;* the manner of connecting the parts being such, that though the roller itself turns freely on its axis, the entire instrument, when moved by the handle *q*, shall turn only on the cross pin. When it is desired to strikes the weights, the handle of the strike is moved round till the roller pressing against the beam, raises it to the top of the stop and there fixes it. The slot in the stop N, should be of such length as to allow one pointer to rise a little above, as well as fall below the other pointer. When the two pointers, are exactly opposite each other, then will all the parts of the machine be in perfect parallelism, namely, the beam, the scale-boards, and the parallel motion pieces. In every case the parallel motion pieces must be of exactly equal lengths between their points of action."

The machine, of which an elevation is given in fig. 2, is similar in all respects to that before described, except in three particulars. First, the uprights B B, and the framework C, of the goods scale-board, are made of iron instead of wood; *second*, the parallel motion pieces G^1 G^1, and J^2 J^2, (see figs. 6 and 7) differ so far from those of the machine first described, that they oscillate on steel bits, let into notches in the uprights B B, and in the vertical arms of the scale-board; and *third* the two ends of the cross bar of the beam are knife edged, and rest in steel sockets let into openings in the tops of the uprights.

Fig. 3 represents a machine constructed on the same principle as the two preceding machines, but differing considerably in the details.

"The uprights or standards B B are of iron instead of wood. The scale-boards F and L are both of the same weight, so as to balance each other exactly, and made on the same plan as the goods scale-board in the machine first before described, with the exception that their frames are of iron covered over with wooden planks, secured by transverse slips of iron. The scale-boards are kept level by means of parallel motion pieces similar to those before described, which move upon triangular bits of steel, fixed in iron bars, which serve as substitutes for the holdfasts employed in the machine first before described. The middle bars have four knife edges each, and the four others have two each. The bars *u x* serve also to connect the two uprights transversely, as do likewise the bars *t*, *v*, *a*, *y*, to connect the vertical arms of the scale-boards. Instead of one beam there are two beams with equal arms, one at each side of the machine, connected by a cross bar Q, which has its bearings in the upright B B, and is furnished, on its under surface, with two knife edges *z z*, one at each end, which play in steel grooves let into openings in the top of the uprights. The scale-boards are suspended from the beams in precisely the same way as the goods scale beam of the machine first before described. U is a strike, consisting of a roller, which turns in bearings in the foundation frame, under one of the scale-boards, and by moving which that scale-board can be raised and fixed."

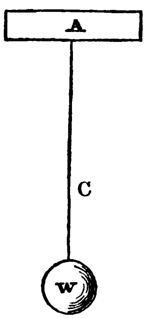
Among the other modifications described by the patentee, there is one for weighing *without shifting weights*, by means of a weighted lever, remarkable for the novelty and efficiency of its arrangements, and likely to become a favourite; though no doubt it admits of being simplified, and would be the better of all the simplification possible.

MATHEMATICAL DEMONSTRATION OF THE PRINCIPLES OF DREDGE'S PATENT IRON BRIDGES. BY THE INVENTOR.

The simplest form of tension in a cord or chain, is that where the cord itself hangs in a vertical direction, and is fastened at the upper extremity to an immoveable block, whilst to the other, or lower extremity, is attached the weight acting in the direction of gravity; this weight, so applied, is equal to, and measures the tension which exists in the chain, or cord.

For in fig. 1, let A represent an immoveable block, C A cord, or chain, attached to it, and W a weight applied at the lower extremity of the cord C; then, disregarding altogether the weight of C, the amount of tension produced is every where the same, and is exactly equal to,

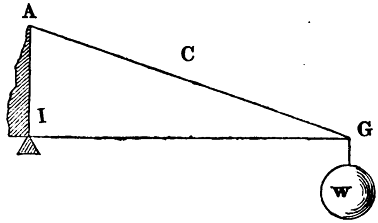
Fig. 1.



and measured by the magnitude of the weight W. This is evident, for the weight W, and the tension in the cord C, act in opposite directions, and therefore, the magnitude of each to obtain equilibrium must be equal. Also, since the entire weight, acting in the direction of gravity, is accumulated at the lower extremity, every part of the cord C must be equally stretched, and hence, the strain, or tension, is the same throughout.

If the cord C, fig. 2, instead of hanging and sustaining the weight W in a vertical position be inclined to the horizon at an angle A G I, less than 90°, the tension which exists in it, is of greater magni-

Fig. 2.



tude, and not measured by the weight W. For in order to preserve the cord C in an inclined position, and maintain the equilibrium of the bracket, it is necessary that a third force, viz., the horizontal force acting in the line G I, should be called into action. Hence it is easy to perceive from the conditions of the problem, that three forces must be concerned to effect the equilibrium, and these are,

1. *The weight* W *acting in the direction of gravity.*
2. *The tension in the cord* C *in the direction* G A.
3. *The horizontal thrust, or force in the direction* G I *and parallel with the horizon.*

Since then, all three of the abovementioned forces are necessary for the equilibrium of the bracket, it follows that either one of them must be the resultant of the other two; and the three, if laid down upon paper, would exhibit a triangle, the length and direction of whose sides would represent the magnitude and direction of the force. Now the direction in which the weight W acts, and the line G I, in which the horizontal force is resisted, are at right angles the one with the other, and the remaining force, viz., the tension, which exists in the line G A, is the resultant of the other two, and must also be the hypothenuse of a right-angled triangle, whose base, and perpendicular is respectively equivalent to the horizontal force, and the weight.

Now, if we put A I to represent the magnitude of the weight W, then I G will be equal to the horizontal force, and A G the tension in the chain, or cord C. By the principles of plane trigonometry:

$$AG = AI \times \text{cosec. } AGI = W \text{ cosec. } AGI.$$

But A G by construction represents the tension in G A: hence,

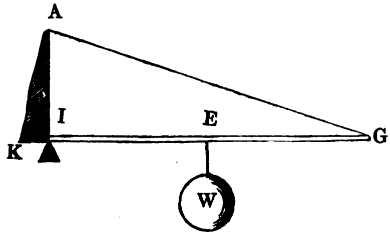
$$\textit{Tension in } GA = W \text{ cosec. } AGI \quad \ldots\ldots \quad (1)$$

and $GI = AI \times \text{cot. } AGI = W \text{ cot. } AGI$,

or $\textit{Horizontal thrust in } GI = W \text{ cot. } AGI \quad \ldots \quad (2)$

If, instead of the whole weight being accumulated at the extremity G, of the lever I G, it be applied at some intermediate point E, fig. 3, only part of the weight acting in the direction of gravity would be sustained by the tension line A C, the remaining part resting on the fulcrum at I. By the property of the lever the relative proportions of the weight supported at the points I and G would be inversely as the distances I E and E G, *i.e*

Fig. 3.



$$\mathrm{I\,G : I\,E :: W : W}\,\frac{\mathrm{I\,E}}{\mathrm{I\,G}} = \textit{The proportion of the weight acting at the point } \mathrm{C}.$$

Let m = *The whole length of the lever* I G.
n = *The distance* I E.
w = *The weight applied at* E.
ϕ = *The* $\angle$ A G I.
x = *The magnitude of the tension in the line* A G.
y = *The amount of horizontal force in the line* I G.

By the equations marked (1) and (2), and according to the properties of the lever just stated, we have:

$$x = \frac{n}{m}\, w \text{ cosec. } \phi \quad \ldots . \; (3),$$

and, $$y = \frac{n}{m}\, w \text{ cot. } \phi \quad \ldots .. \; (4).$$

If E be the centre of gravity, at which point we suppose the whole weight of a parallel line I G of uniform texture to be applied, then

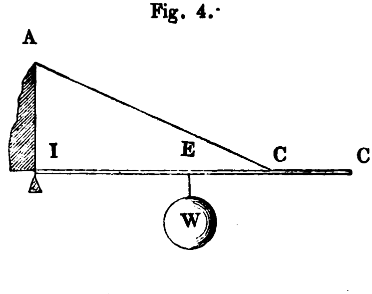
$$\frac{n}{m} = \tfrac{1}{2}\, w, \text{ and}$$

$$x = \tfrac{1}{2}\, w \text{ cosec. } \phi \ldots\ldots . \; (5),$$

$$y = \tfrac{1}{2}\, w \text{ cot. } \phi \ldots\ldots\ldots \; (6).$$

If the angle of direction ϕ of the sustaining force varies, the tension in it also varies; but not so the horizontal force; for so long as the distances I A and n are of the same proportion, and the magnitude of the weight w the same, the quantity of horizontal pressure on the point I is the same also. For, in fig. 4, let the weight, &c., remain as in fig. 3, but let the tension line be attached to any point C in the line I G, then the angle A C I will be of greater magnitude than ϕ, in (fig. 3), but the amount of horizontal force in the line I C will be the same.

Fig. 4.



Put m_o = I C

d = I A

ϕ_o = $\angle$ A C I.

Then, $$y_o = \frac{n}{m_o}\, w \text{ cot. } \phi_o \;\ldots\; (7).$$

The value of y, according to equation (4), is, $y = \frac{n}{m}\, w$ cot. ϕ, which is also equal to $\frac{n}{m_o}\, w$ cot. ϕ_o. For by the principles of plane trigonometry,

$m = d$ cot. ϕ, and $m_o = d$ cot ϕ_o. If we substitute the values of m and m_o in equation (4) and (7), and compare them together, we shall have:

$$\frac{n\,w \text{ cot. } \phi}{d \text{ cot. } \phi} = \frac{n\,w \text{ cot. } \phi_o}{d \text{ cot. } \phi_o} = \frac{n\,w}{d} \; (8).$$

And the same result is obtained whatever position C may assume in the line I G. The value of the tension x_o in the line A C is,

$$y_o : x_o :: \text{cot. } \phi_o : \text{cose } \phi_o :: \text{cos. } \phi_o : \text{rad},$$

$$\text{or,} \quad x_0 = \frac{y_0}{\cos.\ \phi_0} \cdot \cdot \cdot \cdot \cdot \cdot \cdot \quad (9)$$

Hence it appears that the magnitude of the tension varies inversely as the cosine of the angle of direction, supposing every other part of the bracket to remain the same.

Before leaving the subject of the horizontal action in a simple bracket, it may be as well to observe, that the force acting upon the point or fulcrum I, must be in an oblique line I K, and for this reason, viz., that a part of the weight w, equal to $\frac{w\,(m-n)}{m}$, together with the horizontal force, are resisted by the fulcrum I, and the resultant of these forces or line of resistance in the abutment, will be found in the direction I K. For as the weight $\frac{w\,(m-n)}{m}$, and the horizontal thrust $\frac{n}{m}\,w \cot.\ \phi$ are at right angles, the resultant must be equal to, and in the direction of the line subtending the right angle; therefore,

$$\textit{Force in the direction } \mathrm{I\,K} = \sqrt{\left\{\frac{w^2\,(m-n)^2}{m^2} + \frac{n^2}{m^2}\,w^2 \cot.^2 \phi\right\}},$$

which simplified becomes; $\textit{Force in } \mathrm{I\,K} = \frac{w}{m} \sqrt{m^2 + 2\,m\,n + n^2 + n^2 \cot.^2 \phi}\,\}$ (10).

To illustrate these foregoing equations by a numerical example.

Example.—Suppose I G to be a bar 40 feet long, parallel, and of uniform texture, and weighing 25 lbs. per foot; let the whole weight, viz., (2·5 × 40 =) 100 lbs. be accumulated at its centre of gravity E, 20 feet from the fulcrum I, and cause the angle ϕ, which the sustaining force makes with the horizon to be equal to 19°, then the numeral value of the several equations will be shown thus:

$$(1) \text{ by equation (3), } x = \frac{n}{m}\,w \operatorname{cosec.} \phi, = \frac{20}{40} \times 100 \times \operatorname{cosec.} 19° =$$
$$50 \times 3{\cdot}07155 = 153{\cdot}577 \text{ lbs.}$$

Therefore, a power of 153·577 lbs. is required in the tension line A G to balance a load of 100 lbs. applied at the middle of the lever, the angle of direction of the tensile power being 19° with the horizon. The data remaining as before, we get for the value of the horizontal thrust by equation (4),

$$(2) \quad y = \frac{n}{m}\,w \cot.\ \phi = \frac{20}{40} \times 100 \times \cot.\ 19° = 50 \times 2{\cdot}904211 = 145{\cdot}21 \text{ lbs.}$$

Let the bracket assume the conditions exhibited in fig. 4, the distance I C being equal to 27 feet,

$$\text{Equation (7), } y_0 = \frac{n}{m_0}\,w \cot.\ \phi_0 - \frac{20}{27} \times 100 \times \cot.\ \mathrm{A\,C\,I}.$$

By the calculus of sines I A, or d, is equal to,

$$\text{Tan. } 19° \times 40 = 13{\cdot}773. \text{ And tan. A C I} = \frac{13{\cdot}773}{27} = {\cdot}510111{\cdot} = \text{tan. } 27°\ 1'\ 34''.$$

$$\text{Now } \frac{20}{27} \times 100 \times \cot.\ 27°\ 1'\ 34'' = 74{\cdot}074 \times 1{\cdot}960359 = 145{\cdot}21 \text{ lbs.}$$

This being precisely the same as the amount of horizontal thrust before obtained, when the tensile cord was attached to the extremity of the lever in an angle of 19°, we infer, that so long as the position of the weight remains constant, the same horizontal thrust will obtain, no matter at what point in the lever the cord is applied.

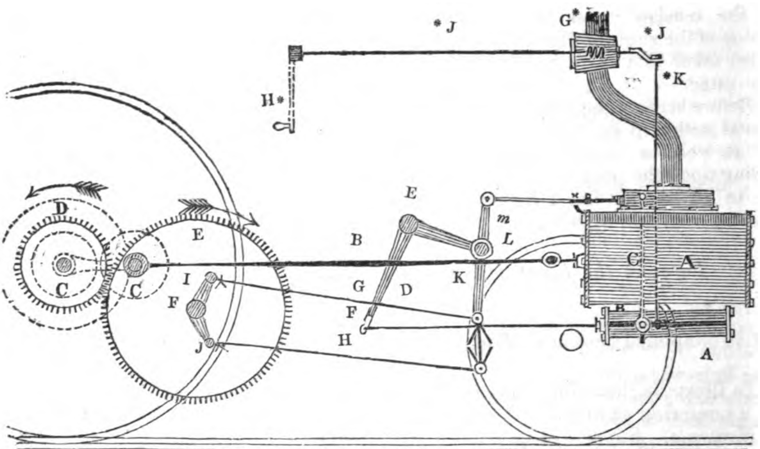
JAMES DREDGE.

Bath, February 15, 1843.

(*To be continued.*)

APPLICATION OF THE SUN AND PLANET MOTION TO OUTSIDE CYLINDER LOCOMOTIVES; WITH A PLAN FOR WORKING THE SLIDE-VALVES, AND A SELF-ACTING REVERSING APPARATUS.

Fig. 1.



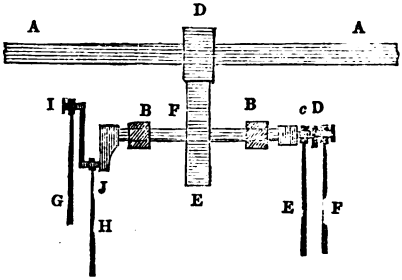
Sir,—On perusing your Magazine for last month, I was rather surprised to find a communication, signed "Inventor," on the application of the sun and planet motion for reducing the speed of the pistons and valves of locomotive engines, as I also had prepared one something similar, on the application of that motion for lessening the speed of the working parts of a locomotive engine; but finding that the plan now used for working the valves of our crank engines would not be applicable in this case, I kept it back till I should be able to accompany it with a plan for that purpose, a drawing and description of which I now send you for insertion in your Magazine, together with a plan for reversing and managing a locomotive engine with the handle of the steam-cock alone.

Description of the Engravings.

Fig. 1. A, the cylinder; B, the connecting-rod; C C, the sun and planet wheels, shown by dotted lines; D, a cog wheel fixed to the centre of the driving-shaft, and working the toothed wheel E, (of exactly twice its diameter,) fixed on an extra shaft F, (working in supports fixed to the engine,) with four cranks bent upon it for working the slide-valves, (see fig. 2;) G H are two forked rods connected to two of the said cranks, I J, for working the lever K, fixed to the rocking-shaft L; M, another lever fixed to the same shaft, for working the valve.

Fig. 2 exhibits a side view of the crank-shaft F—(the letters in fig. 1 refer to the same parts in this drawing.) A A, driving-axle; B B, the crank-shaft supports; C D, cranks connected with the forked rods E F, for working the valves of the other cylinder. This plan may be applied to crank locomotives, by making the cog-wheels D E of equal size; and I

Fig. 2.



apprehend that it would be attended with far less friction than the four eccentrics.

The self-acting reversing contrivance is shown in fig. 1. A is a small cylinder fixed (in the centre) at the bottom of the smoke-box, (what I term the reversing

cylinder;) B, a four-way cock attached to it, with the steam-pipe C (shown by dotted lines) connected with the valve-box; D, a bell-crank, which turns on a centre E, and connected to the piston-rod of the reversing cylinder by the slot F, the other end being connected by small coupling-rods to the forked rods G H; G*, the steam-cock, with its handle H* fixed to the rod J*, shown by dotted lines in the position with the steam cut off from the cylinders; at the other extremity of the rod there is a small crank, J*, fixed at a right angle with the steam-cock, and connected with the lever of the four-way cock of the reversing cylinder by the rod K*.

By way of illustration, it will easily be perceived, that, if the handle of the steam-cock be moved out of its present position, in either direction, the lever of the four-way cock of the reversing cylinder will be moved accordingly, and the steam being admitted therein, the engine will be immediately reversed.

To prevent concussion of the piston against the ends of the reversing cylinder (if any,) various plans might be proposed: the one which seems to me the simplest is, to fix a tight boss of gasket at each end (in the inside) of the cylinder.

Yours respectfully,

ROBERT HINDLE, Jun.

Preston, March 4, 1843.

NEW MODE OF EFFECTING THE VOLTAIC DEPOSITION OF SILVER.

Sir,—It has been very generally admitted, that to silver objects by the electro-decomposition of the solution of NITRATE of silver is an exceedingly difficult, not to say impossible, operation. Considering this, I have little doubt but the following hint will become of service to electrotype experimenters.

Prepare the neutral citrate of silver by dissolving the oxide of the metal in a solution of citric acid; evaporate to dryness, and place the residual salt in a porcelain tube, heated to the temperature of 212° Fahr., after which a current of dry hydrogen gas must be passed over it, for a few minutes. The most convenient way of managing this will be to allow that part of the tube containing the salt to go through a vessel holding water, heated to the boiling point. As soon as the apparatus is cool, the salt may be taken out, and dissolved in COLD distilled water, and then decomposed by any of the voltaic processes employed for precipitating the metals.

By employing this salt, the preparation of which, it will be seen, is very easy and simple, I have obtained a very fine deposit of silver, and such a one as I never even approached by the use of the *nitrate* of the metal. In fact, with the latter, I never obtained any thing but a non-metallic looking powder, even with every possible precaution; and I am informed the labours of the most learned philosophers have been attended with little better success.

I have no doubt but a similar salt of GOLD may be obtained, of equal utility in precipitating its metal in a desirable form; and, in all probability, the cheaper kinds of the vegetable acids may be used in lieu of the citric, which is rather dear, costing at present about 1*s*. per ounce. The tartaric, in particular, I would recommend as worthy a trial, the retail price of which is, I believe, only 2*d*. an ounce.

By the action of the hydrogen gas, a peculiar change appears to take place in the salt of silver; its solution is of a deep brown colour, and it must not be warmed, as it then instantly decomposes into a black powder, and the neutral citrate, which remains in the solution in its usual state. This peculiar alteration was first observed by some eminent chemist, whose name, at this moment, I do not remember. The salt, to me, appears to have suffered a partial deoxidizement.

Believe me yours, &c.,

Z. ROCKLINE.

December 1, 1842.

THE PORCELAIN TOWER OF NANKIN.

Nankin, September 19, 1842.

Sir,—If you think the following remarks worthy of a place in your valuable Journal, I shall be much pleased by their insertion.

The sides of the famous Porcelain Tower of this place are *entirely* covered with either porcelain tiles, or bricks composed of a coarse kind of earthenware, the outer sides finely glazed, and coloured according to the nature of the part to which they are applied. The high state of pre-

servation which this wonderful edifice is in is extraordinary, and it is scarcely credible, when looking at its fresh and beautiful sides, that four hundred years have passed since its completion; proving, incontestably, the great durability of this singular mode of building.

Would it not, then, be worth while to try the application of glazed bricks in the construction of buildings in England? only one side of the brick would require to be glazed, and this, I should think, could be done for a small extra expense. I am convinced, from the observations I have made on the fine preservation of the Porcelain Tower, that the durability of an edifice having its sides protected in a similar manner would fully repay the first outlay.

I have enclosed a small fragment of the pagoda, which is not only an interesting relic, but conveys a better idea of the composition of the bricks I have alluded to. The tiles are of *pure porcelain*, and are very beautiful.

I am, Sir, yours truly,

HENRY DUNCAN CUNNINGHAM.

[We have shown the specimen, kindly forwarded to us by our correspondent, to a Staffordshire potter, who pronounces both the porcelain and the glaze to be of very indifferent quality; but likes the idea of Porcelain Towers so well, that he says he should like to have "an order for a gross of them"!—ED. M. M.]

MEMOIR OF THE LATE SIR JAMES IVORY.

[From the Annual Address of the President of the Royal Society, the Marquis of Northampton.*]

Mr. James Ivory was the son of Mr. James Ivory, watchmaker in Dundee, and was born in that town, in the year 1765. He received his elementary education at the public schools of Dundee, and in the year 1779 was sent to the University of St. Andrews, where, in the period of four years, he went through a course of languages, science, and philosophy, entitling him to the degree of Master of Arts, which was afterwards conferred on him. While at this university, he was distinguished for his attainments in mathematics, to the study of which branch of science he had, even at this early period of his life, particularly applied himself, under the able instruction of the Rev. John West, at that time assistant to the professor in the university. It reflects equal credit upon the pupil and the instructor, that for this gentleman Mr. Ivory ever after entertained the highest regard.

Being intended for the church of Scotland, he now commenced his studies in theology, and in the prosecution of them remained two years at St. Andrews, after the completion of his course of philosophy. He then removed to the university of Edinburgh; and it is not a little remarkable that he should have done so with Leslie, who had been his fellow-student at St. Andrews. At Edinburgh he received his third year's theological instruction, necessary, by the regulations of the Scottish church, to qualify him for admission as a clergyman. His studies in divinity were not, however, prosecuted farther; for, immediately on leaving the university of Edinburgh, he was, in 1786, appointed assistant-teacher in an academy then instituted in his native town of Dundee, for the purpose of instruction in mathematics and natural philosophy. Having remained in this situation three years, he entered upon a totally different career, becoming a partner in, and the manager of, a flax-spinning company, which had its mills at Douglastown, in Forfarshire, and which assumed the name of James Ivory and Company.

Though now engaged in commercial and manufacturing pursuits, Mr. Ivory still devoted every moment of leisure to his favourite object, the prosecution of mathematical investigations. Living in a secluded part of the country, he was debarred from the advantages of access to libraries and the society of men of science, which a more favoured locality might have afforded him; but this obstacle to the enlargement of his knowledge was overcome by the force of his genius and his powers of application. With a sound knowledge of the geometry of the ancient and of the modern mathematics of his own country, he had already possessed himself of the methods and discoveries of the continental mathematicians, at that time almost wholly unknown in Britain; and he early led the way in that path, which he afterwards followed with unrivalled success.

His earliest memoir, read before the Royal Society of Edinburgh, on the 7th of November, 1796, and published in its Transactions, shows, not only that at this time he was well acquainted with the works, and possessed the methods, of the most celebrated of the continental writers, but that he could advance independently in the track which they had discovered and so successfully pursued. This memoir, entitled "A New Series for the Rectification of the Ellipse, together with some Observations on the Evolution of the Formula $(a^2 + b^2 - 2\,a\,b\cos\phi)^n$," besides

* Philosophical Magazine, February, 1843.

displaying considerable analytical skill in the accomplishment of its immediate object, shows that the solution of the highest class of physical problems had already engaged the author's attention.

Two other memoirs, communicated by Mr. Ivory to the same Society, one in 1799, "A New Method of Resolving Cubic Equations," and the other in 1802, "A New and Universal Solution of Kepler's Problem," both indicate great originality of thought and powers of investigation. The approximation which he gives in the latter memoir for the determination of the eccentric anomaly is remarkable for its simplicity, universality, and accuracy.

At this period Mr. Ivory was in correspondence with Professor Playfair, Mr. Leslie, (afterwards Sir John Leslie,) Mr. Wallace, and Mr. Brougham, (now Lord Brougham,) and with these eminent persons his intercourse was ever after continued, until interrupted by the death of one of the parties. To the well-founded recommendation of Lord Brougham he was indebted for the grant of a pension of 300*l*. per annum, in 1831, by King William IV.

Released from the anxieties of mercantile speculations, by the dissolution of the company of which he had been the manager, he, in 1804, applied for, and immediately obtained, one of the mathematical professorships in the Royal Military College at Marlow, (afterwards removed to Sandhurst.) During the time that he was connected with this institution, he acquired the esteem and regard of the authorities of the college, of his colleagues, and of his pupils. In the discharge of his public duty he appears to have been altogether exemplary; and he was universally considered to be one of the best and most successful instructors that had ever been connected with the college.

He now became better known in the scientific world; and while he discharged the important duties of his professorship to the advantage of the college and the advancement of its character, he communicated to the public many important memoirs on various scientific subjects, which appeared in the Philosophical Transactions, in Leybourn's Mathematical Repository, Maseres's Scriptores Logarithmici, and the Supplement to the sixth edition of the Encyclopædia Britannica.

About the year 1816 his health began to give way, under the confinement consequent upon close application to his professorial duties, and devoted attachment to scientific inquiry; and he was compelled by bad health to resign his professorship. The estimation in which he was held by the authorities of the college cannot be more conclusively shown than by the fact that, when disabled by ill health from performing his arduous duties, the governor and the commissioners of the college recommended and procured the retiring pension to be given to him, some years before he had completed the period of service which the regulations of the War Office at that time required. He now took up his residence in London; and in this metropolis or its environs he spent the remainder of his days, living always in great retirement.

Disengaged from professional duties, though still suffering in health, he now devoted his whole time, and all the energies of his powerful mind, to the investigation and elucidation of various mathematical problems of the highest order; and the result of his inquiries were given to the world in numerous elaborate memoirs, many of the most important of which, it is gratifying to reflect, adorn the volumes of our Transactions. It is no less gratifying to feel that this Society was at the time fully alive to the value of these communications, by awarding to their author, on successive occasions, the highest honours in its power to bestow.

In 1814, Mr. Ivory received the Copley medal "for his various mathematical communications printed in the Philosophical Transactions."

In 1826, one of the royal medals was awarded to him "for his paper on astronomical refractions, published in the Philosophical Transactions for the year 1823, and his other valuable papers on mathematical subjects." And again, in 1839, he received one of the royal medals, "for his paper on the theory of astronomical refractions, published in the Philosophical Transactions for 1838," which paper was the Bakerian lecture for the year.

If Mr. Ivory's rank among the mathematicians of his age could be assigned, independently of his communications to the Royal Society, he must still occupy a distinguished place, not only among those of his own country, but of Europe. It was, however, by the communications with which he has enriched our Transactions that he gained the great scientific reputation which he enjoyed; and it is with them, also, that we are more immediately concerned.

These papers may be classed under eight different heads; for, although several of them are closely related in regard to their physical objects, yet the nature of the mathematics employed in them is so different, that we should do injustice to his reputation if we arranged them under one head.

*   *   *   *

To show the estimation in which Mr. Ivory's talents and labours were held by

Laplace, we may here quote a remark from Sir Humphry Davy's Address, in 1826, on the award of the royal medal to Mr. Ivory. "I cannot pretend," says our, then, distinguished president, "to give any idea of the mathematical resources displayed in the problems, and which even the most accomplished geometer could not render intelligible by words alone; but I can speak of the testimony given by M. de Laplace himself in their favour. That illustrious person, in a conversation which I had with him, some time ago, on Mr. Ivory's first four communications, spoke in the highest terms of the manner in which he had treated his subject; one, he said, of the greatest delicacy and difficulty, requiring no ordinary share of profound mathematical knowledge, and no common degree of industry and sagacity in the application of it."

* * * *

The great scientific reputation which Mr. Ivory had established by these, and other memoirs not communicated to the Royal Society, ensured his election into this Society in 1815, and into many of the other scientific societies of this country and of the Continent. He was an Honorary Fellow of the Royal Society of Edinburgh, an Honorary Member of the Royal Irish Academy, and of the Cambridge Philosophical Society; Corresponding Member of the Royal Academy of Sciences of the Institute of France, of the Royal Academy of Sciences of Berlin, and of the Royal Society of Gottingen.

In 1831, the Hanoverian Guelphic Order of Knighthood was conferred on him by King William IV., and it was intimated that he might also receive the British knighthood; but this he declined, as the title would have been inconsistent with his circumstances. He had, however, as has already been stated, a pension of 300*l.* per annum subsequently conferred on him by His Majesty. In 1839, the University of St. Andrews conferred on him the degree of Doctor of Laws.

Although his health had been early impaired by his close application to scientific investigation, he never allowed himself to be unoccupied, but was constantly engaged in his researches, to the period of his last illness. In the end of last year his health became seriously impaired; and after an illness of several months, but retaining his faculties to the last, he died on the 21st of September of the present year, aged 77. He was never married.

HARMONY OF NUMBERS.

[Mr. Sterland, whose simple and convenient method of calculating commission, brokerage, &c., we inserted in our 1019th Number, p. 132, has since published a second edition, to which there is appended the following curious addition.]

The harmony of numbers is strikingly exemplified in producing the following *trio* of shillings,—viz., 5, 10, and 15, by multiplying any number of pounds by double the amount of any rate per cent.

FRACTIONS OF RATES PER CENT.

When the *unit* of any number of pounds		at $\frac{1}{8}$ or $\frac{5}{8}$ is	at $\frac{1}{4}$ or $\frac{3}{4}$ is	at $\frac{3}{8}$ or $\frac{7}{8}$ is	at $\frac{1}{2}$ is
is 2 or 6, and the *ten* is	0, 2, 4, 6, or 8,	10	——	10	——
	1, 3, 5, 7, or 9,	——	——	——	——
When the *unit* is 1, 5, or 9, and the *ten* is..	0, 2, 4, 6, or 8,	5	10	15	——
	1, 3, 5, 7, or 9,	15	10	5	——
When the *unit* is 3, or 7, and the *ten* is....	0, 2, 4, 6, or 8,	15	10	5	——
	1, 3, 5, 7, or 9,	5	10	15	——
When the *unit* is 0, 4, or 8, and the *ten* is..	0, 2, 4, 6, or 8,	——	——	——	——
	1, 3, 5, 7, or 9,	10	——	10	——

A curious observer will, perhaps, imagine that the seven fractions of rates per cent., viz., $\frac{1}{8}$ to $\frac{7}{8}$, bear some analogy to the seven notes in the musical gamut; and he cannot fail to notice that the 1st and 8th lines, the 2nd and 7th, the 3rd and 6th, and the 4th and 5th lines, in the above columns of this numeral *octave*, are in perfect unison.

The *orders* of the figures in each column are also in perfect unison. Thus, the order of figures in the *first* column of the 4th, 3rd, 2nd, and 1st lines are in unison with those of the 5th, 6th, 7th, and 8th lines, viz., 15, 5, and 10; in the second column they are 10 and 10; and in the third column they are 5, 15, and 10. The second column being added to the first or third, the two totals will also be in unison, viz., 5*l.*

J. Sterland.

MR. BOTTEN'S GAS-METER.

Sir,—I beg to explain that I intended the observations in my letter to you, dated the 6th instant, to apply solely to the contrivance to enable water to flow out of a meter while it is in use; and to show that *none does accumulate* where the service-pipe is properly laid. On the supposition that accumulating water did "*drivel*" over, it might have an offensive odour. But I had not the most remote idea or intention to infer that water would become "*fetid*" in one make of meter sooner than in another.

I believe Mr. Botten to be a highly respectable man, and that his meters may be depended upon in every respect, equal to any others. But I do think the application referred to is not requisite.

I am, Sir, yours respectfully,

SAMUEL BARTLETT.

Maidstone, March 14, 1843.

DESCRIPTION OF THE AMERICAN MODE OF MOVING HOUSES.—BY MR. A. J. MASON.

[Read before the Royal Institute of British Architects, January 17th, 1842.]

Before proceeding to the more immediate subject of this discourse, it may be deemed not improper to offer a few descriptive remarks relative to the place where the plan of removing houses, has been chiefly practised, and also as to the causes which led to the adoption of such an operation. The State of New York, the most important in the North American Union, was discovered by Hendrick Hudson, in 1609; from him the principal river has been named. The place was first settled by the Dutch, in 1614, who named the colony, the New Netherlands; their establishment was on the lower part of the island of Manhattan, which Indian name they altered to New Amsterdam. The province was taken by the English in 1664, who changed the name to that of New York, in compliment to the King's brother, the Duke of York; the town of New Amsterdam received the same appellation. The Duke's second title of Albany was given to the capital of the colony previously called Orange; this is situated 150 miles up the Hudson. The position of the city of New York, now the most populous in America, is admirably adapted for commerce, it being at the confluence of the Hudson and East rivers; the latter being properly an arm of the sea, which saparates Long Island from the city. These rivers terminate in the Bay, which is one of the most splendid in the world for beauty, convenience, and scenic effect. Fronting the Bay is a public promenade, called the Battery, so named, from a fort erected at one extremity; this has been long converted into a place of public amusement, and is called Castle Garden. The Battery, about 10 acres, which is planted with trees, and has numerous walks, was a favourite resort of the old Dutch Burghers, to smoke their pipes; and it is now greatly frequented by the citizens in fine weather.

Since the close of the revolutionary war, in 1783, New York has greatly increased in size and population; the number of inhabitants, at that period, was only 23,000; there are now probably 350,000. Building has gone on to a great extent within the last few years; in 1837, there were 840 new houses erected; in 1838, 781; and in 1839, 674; but in six years collectively, including 1840, there had been built 6270. This statement will give an idea of its increase, and consequently, its importance as a business emporium. The public buildings of consequence are but few; a Custom-house, recently erected, is, though small, a handsome structure; it is fire-proof, no wood being used in any part; the walls, lower flooring, pillars, and roof, are of white marble; the upper floors, doors, and railing, of iron. The New Exchange, just finished, is also a very fine building, and much larger than the old one, destroyed by the great fire, in December, 1835. In the heart of the city, within an enclosed place called the Park, stands the City Hall, the largest and most important structure in New York; this is 215 feet wide, and 105 deep, with a handsome marble front, but is rather too flat in its proportions; within its walls are the Civil Courts of Law, Mayor's office, and other rooms for public business. The City Hotel erected in 1794, was the first building that had a slated roof. The Astor Hotel, so often mentioned, is a large but exceedingly ugly structure, looking like a large wall pierced with holes; it has an insignificant portico, and is farther disfigured by the lower part being divided into shops. Some of the churches recently erected in New York, are very creditable to the city; of the others, many are partially of painted wood. The private dwellings are also all painted on the outside. Broadway, the

principal street, is 2½ miles in length, running perfectly straight; this and some of the other streets owing to improvements, since the Revolution, are now very excellent thoroughfares. In New York, as in other parts of America, many of the streets are planted with trees on the side walks; this renders them very pleasant in warm weather, besides looking exceedingly picturesque. In 1835, about 100 yards of wooden pavement was tried in Broadway, and answered the purpose so well, that it has been adopted in many other parts of the city; most of the street crossings have been so paved, and the plan has been found to be excellent. Some of the recent portions, however, have been executed too hastily, and get soon out of order. This mode of hurrying matters is quite characteristic of the Americans, whether in paving, building houses, or otherwise; immediate expediency being thought of in preference to durability, on their standard principle of "going ahead."

It is a remarkable circumstance that there is no gravel in New York or its vicinity; St. John's or Hudson-square is the only place in the city that has its walks gravelled, and when that was laid out the gravel was brought from a considerable distance. There are no large docks for shipping, as in London; but wharfs or piers are built out into the water on both sides, the vessels finding secure anchorage in the slips between. On the East river are the screw and dry docks, for repairing shipping; in the screw dock the vessel to be repaired is floated in, and received on a cradle, which is attached by screws to platforms on either side at a height of about 25 feet; the screws are wrought by powerful levers, and the vessel is gradually and vertically raised from the water, and can be repaired with ease. In the dry dock, by a similar process, the ship is drawn out of the river, on an inclined plane, to the land, but is not raised up as in the screw dock. I am not aware whether there may be any novelty in these plans, but they seemed to me ingenious and complete.

The limits of the city extend to Harlaem Creek, a narrow stream that runs from the East to the Hudson river, and divides it from the main continent. The whole of the space alluded to, which is yet unbuilt on, has been planned in straight intersections, called avenues or main roads; these are crossed at equal distances by streets at right angles. This mode is followed in all the new erections, both in New York, and in other American cities. The city has at present but few open spaces like our squares; but in the newly built parts the citizens have exhibited a growth of wisdom, beyond the confined ideas of their Dutch ancestors, and are now constructing wide streets, and an occasional square. A great portion of the new houses in the upper part are (I have understood) erected by English capitalists, who have encouraged the style of their own country, introducing balconies and other appendages of improved taste.

From its commercial situation, the real property of New York is of great value; I will mention one instance,—after the great fire of December, 1835, a lot of vacant ground in the rear of the Exchange, measuring about 26 yards by 20, sold for 111,000 dollars, being 48*l.* 10*s.* per square yard. This certainly is the most valuable portion of the city, but the adjacent parts are of considerable worth also. As may be supposed, rent is exorbitantly high; it is true that the tenant rarely pays any direct tax; but the rents of late years have so increased, as by far to overbalace rents and taxes together in this country. I speak from my own knowledge in stating that, taking one mile from the Exchange in either city, that for the same description of house the rent is almost double the amount in New York, that it would be in London.

I have thus far attempted to give a brief idea of the present state of this important and rising place. I shall now revert to its former condition, in order to lead to my ostensible subject. The first Dutch settlers established themselves on the flat grounds at the lower end of the city, which during their supremacy never extended higher than Wall-street, at which place a strong barrier wall was erected to protect them from the incursions of the Indians. From this *wall* the street of course derived its name. In time they had farms and plantations beyond the wall. They had no fixed plan in forming their streets, their houses being at first casually placed, according to convenience. The street now known as Pearl-street is very devious in its course, commencing near the Battery, and, after winding about, entering Broadway

in a much higher part of the present city, and far beyond the boundaries of the old town. Pearl-street is supposed to have been one of the old cow-paths, and the peculiar form of it to have arisen from the necessity of avoiding the swamps and marshes that lay on either side. These swampy spaces greatly prevailed in all the low parts of the place, and were very productive of sickness; foreigners, more especially, who lived in their vicinity, were very subject to fevers and agues. Many of these marshes existed in the upper part of New York after I resided there; and where the inhabitants were thinly scattered, the ear was frequently regaled, in a summer's evening, by a most hideous croaking noise from colonies of frogs: this is figuratively known as a *frog concert*. The action of the sun on these swamps during the hot months, together with the confined air of the old narrow streets, occasionally produced another and more fatal disorder, the yellow fever. This dreadful pestilence is now chiefly confined to the southern states, but formerly it visited New York at intervals of a few years. In 1798 it raged most fearfully: out of the then city population of 50,000, 30,000 fled from fear of the pestilence; out of the 20,000 left, 300 died in a week. The last visitation of the yellow fever was in 1823, when the late celebrated Matthews went over: but theatrical amusements were for a time entirely suspended. The policy adopted since that period, of levelling the hills and filling up the hollow marshes, though tending to produce a dull kind of uniformity to the eye, has, in many respects, greatly improved the health of the inhabitants. Broadway, the centre and principal thoroughfare, has been termed the backbone of New York, and from it there is a descent, although slight, to the river, on either side of the city; and this plan of levelling and filling up has been, and will be, entirely the rule of action in the farther extension of the city, the whole length to Harlaem Creek.

A few years before I went to America, great discussion had taken place as to the best mode of draining the city of New York whether by underground sewers or drains above, and eminent medical men who were consulted gave their judgment in favour of the latter, as being more likely to prevent illness from unwholesome effluvia being confined, the more especially as the tides rise so high, that sewers could not so well answer the purpose. There is but one underground sewer, as far as I know, in New York; and this was formerly a narrow channel from the North river, which has been arched over to form a street. Probably the grandest improvement that has taken place, both as regards the appearance of the city, and the health of the community, is that of widening the old narrow streets by producing more free ventilation. Many were so improved during my residence; and although the alterations have been highly beneficial, they fall hard on the holders of property in the immediate vicinity, who are heavily taxed to meet the expenditure. The remnants of antiquity which existed at the commencement of these improvements, in the shape of Dutch and other old buildings, were by degrees destroyed to make way for the new and more commodious edifices; for there is no antiquarian taste or feeling in the New York people that is ever permitted to interfere with immediate expedience and profit. During the early part of my residence, there were several old Dutch and other houses standing, all of which are gone, with, I believe, one exception, in New-street, which *New*-street, by the way, is now quite ancient. I engraved a view of a genuine specimen of Dutch architecture, which I often saw. I have also a print of another wood-cut, which I executed, of the French church, erected in 1704, by a body of the Huguenots, who fled from France, after enduring much persecution, through the revocation of the edict of Nantes by Louis XIV. in 1685. These enterprizing strangers also founded a small town about twenty miles from New York, which they named New Rochelle; here they carried on farming and other operations, paying weekly visits to the city for the purpose of public worship. A curious old building, called the Tiled Cottage, from being the only one left with tiles on the roof, was also pulled down while I was there; it was remarkable as being the place where the celebrated negro plot for murdering the white people, was arranged in 1740; it was discovered in good time for prevention, and the criminals were punished,

though with some cruelty.* The street alterations and improvements are at the discretion of the city corporation, whose jurisdiction extends to Harlaem creek before mentioned. When the widening of a street is determined on, a printed notice is put on every house lying in the way of the proposed amendment; by this notice the proprietors are required to remove them by a certain specified date. This is often felt to be somewhat arbitrary, but private convenience has to give place, where the public good is concerned. Where the houses are of little value, they are pulled down; but if otherwise, they are moved back in preference, that operation being less costly, and more expeditious, than pulling down and rebuilding, always bearing in mind that the house is of adequate value. I remember when the American mode of moving buildings was first spoken of in this country it was wholly disbelieved, but the truth of it has long been established, particularly as regards wooden houses. These have even been carried to a considerable distance; I saw one on a huge wagon drawn by a dozen oxen in progress on the main road in the suburbs of New York; and another of two stories, drawn by twenty-four oxen; this was in Newark, about 9 miles from New York; these removals of wooden buildings from place to place, now very rarely occur, though at one time frequently.

(*The conclusion, with illustrative engravings, in our next.*)

* The writer seems not to be aware that this conspiracy is now generally considered by the best authorities to have been entirely imaginary.—Ed. M. M.

NOTES AND NOTICES.

The last Fastest Steamer.—During the last fortnight a new steam-vessel has made several trips up and down the river, and her speed has created very great astonishment. She has been built for the Waterman's Steam Packet Company by Messrs. Napier, the engineers of Millwall, whose two fast boats, the *Eclipse* and the *Isle of Thanet*, excited great attention on the Ramsgate and Margate station last year. The hull of the new vessel is formed of iron, and the immense speed has been obtained by an improvement of a very peculiar description. There is a false bottom, which forms a condenser, and by condensing the steam in the vacuum thus formed the whole power of the engine (for there is only one, and of no more than 30 horse power) is applied to the driving of the boat, instead of being wasted in pumping water into the ordinary condensers. The steam is drawn into the condenser by an air pump, and the cold water passes under and over it. The machinery occupies a very small space, and the consumption of fuel does not exceed a ton and a half per day. With these very small means, Messrs. Napier have succeeded in obtaining a speed unequalled in the annals of steam navigation. Her ordinary speed with the tide is 18 miles an hour; but she has actually proceeded down the river with the ebb-tide at the rate of 19 or 20 miles an hour. In one of her recent trips she performed the distance from London-bridge to Greenwich Hospital, exactly 5 miles, in 16 minutes, and on the following afternoon the same distance was effected in one minute less. The *Father Thames*, a very fast Gravesend steamer, with two engines and machinery of 35-horse power each, was passed by the new steamer, and there is nothing on the river which can at all compete with her. She is to be called Waterman No. 9, and is intended to ply between the Adelphi pier and the watermen's floating pier at Greenwich. The new steamer in appearance is anything but a handsome one, but for strength and speed she has never been surpassed.—*Times*, March 11. A correspondent (Mr. J. Halse, of 61½, Threadneedle-street,) has reminded us, that on the 29th of October last he proposed in a letter to us precisely the same plan, which the Messrs. Napier have adopted. We have referred to the letter of which he speaks, and find the fact to be so. It is in these terms:—Sir,—"Allow me to suggest for your consideration an improvement in Marine Steam Engines which has occurred to me: it is to the effect that much would be gained by contriving that the *condenser* should form the bottom of the vessel (ship or boat), in such a manner, that the water it passes through in its passage should supersede the body of water which is now carried, adding much, both in point of bulk, and also weight; at the same time this plan would prevent the raising of temperature in the condenser, which is, under the present system, a great evil and of frequent occurrence. The external shape might be so contrived, that its resistance to the water it passes through should be but trivial."

The "Terrible" Steam Frigate.—The Lords of the Admiralty last year approved of a plan submitted by Mr. Oliver Lang, Master Shipwright of the Woolwich Dockyard, of a steam frigate on a larger scale of dimensions and power than any hitherto constructed, and ordered her to be named the *Terrible*. It is now contemplated that this splendid steam frigate shall be built at Deptford Dockyard. The following are to be her dimensions:—

	Feet.	Inches.
Length between perpendiculars ...	226	0
Keel for tonnage..........	196	10½
Breadth extreme..........	42	0
Depth in hold	27	0
Burden in tons..........	1,847.	

She is to be supplied with a pair of Messrs. Maudslay and Field's patent double cylinder marine engines of 800 horse power. The cylinders will be 72 inches in diameter, and the erection of the engines alone has been contracted for at the cost, including the boilers, of 40,250*l*. The engine-room will be 75 feet long, 38 feet broad, and 27 feet deep; and the weight of the engines and requisite gear connected with them will be upwards of 500 tons. The diameter of the paddle-wheels are to be 34 feet by 13 ft. in breadth. The coal-boxes will contain 800 tons of coals.

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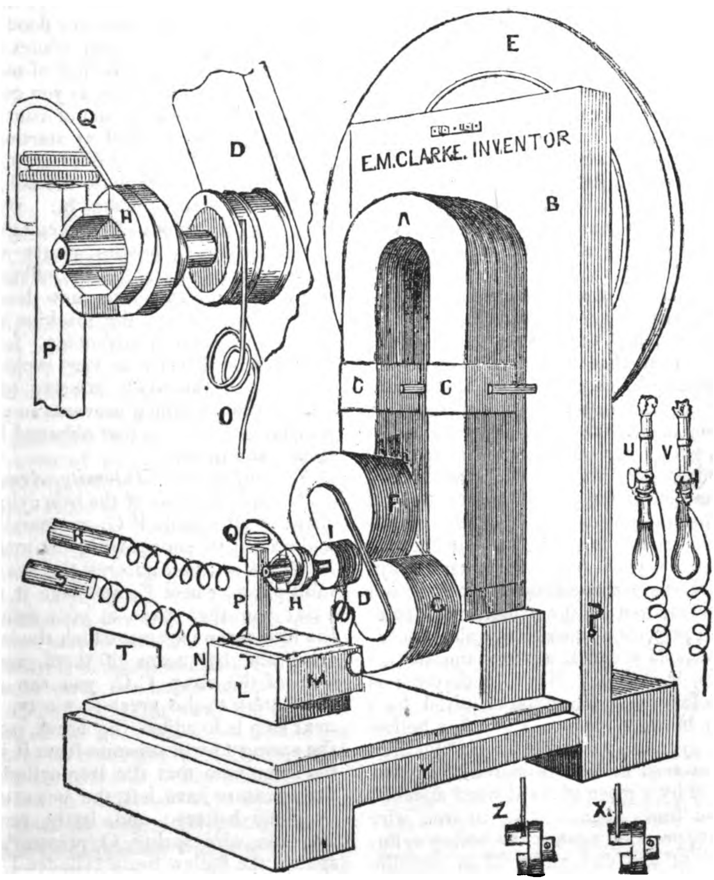
CLARKE'S COLOSSAL MAGNETO-ELECTRIC MACHINE.



CLARKE'S COLOSSAL MAGNETO-ELECTRIC MACHINE.

We quoted, in No. 1022, from a contemporary journal, a brief notice of the colossal magneto-electric machine at the Polytechnic Institution; and have been since favoured by Mr. E. M. Clarke, (of 428, Strand,) by whom it was constructed—or, more properly speaking, invented, for it is distinguished by other peculiar properties besides its unrivalled magnitude—with the following more complete description.

The apparatus, with the exception of its having rotating armatures and a magnetic battery, differs from every machine before constructed; but more particularly in its operating without the aid of mercury. A, (see fig. 1 on our front page,) is the battery of bent bar magnets, placed *vertically*, and resting against four adjusting screws, which pass through the mahogany back-board B. C B are two stout brass straps, passing through openings in the back-board, through which pass bolts and nuts, the purpose of which is to draw the magnetic battery to the board B. By these means, the battery can readily be disengaged from the machine, without taking asunder the entire apparatus, and the battery is thus also freed from that vibration which must necessarily be occasioned by the attachment of the rotating apparatus to the battery itself. D is the intensity armature, which screws into a brass mandril seated between the poles of the battery A; motion being communicated to it by the multiplying wheel E. This armature has two coils of fine insulated copper wire, 1500 yards long, coiled on its cylinders, the commencement of each coil being soldered to the armature D, from which projects a brass stem, (also soldered into D,) which carries the break-pieces, H and H. Each break-piece is made fast in any position required, by a small binding screw. I and I, a hollow brass cylinder, to which the terminations of the coils F G are soldered, being insulated by a piece of hard wood attached to the brass stem. O is an iron wire spring, pressing against the hollow cylinder I at one end, and held in metallic contact by a nurled head-screw in the brass strap M, which is fixed to the side of the wooden block L. P and P a square brass pillar, fitting into a square opening in the other brass strap N, and secured at any convenient height required. Q and Q a metal spring, that rubs gently on the break-piece H, and is held in perfect metallic contact by the nurled head-screw in P. T and T a piece of copper wire for connecting the two brass straps M N: then D H Q P N are in connexion with the commencements of each coil, and I O M with the terminations.

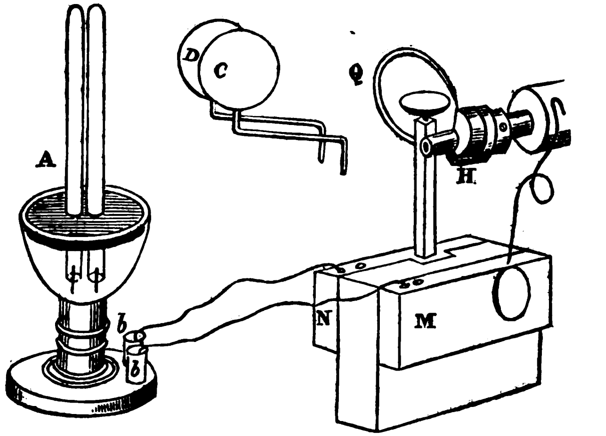
The advantages of the above arrangement must be obvious to any person who has seen the magnetic machine in action at the Adelaide Gallery, where the old arrangement of the mercury flood is still used, where both disc and blades scatter the mercury about. The loss of mercury is not the only evil; for, as you continue working the machine, you of course lose the adjustment you had at starting, and the effect is constantly diminishing, and at length ceases, owing to the points not having mercury to dip in. By Mr. Clarke's ingenious arrangement, the metal spring Q presses gently on the break H; consequently, the effects here are unbroken, no matter how long you may require to keep the machine acting. Nor is this the only advantage; for with mercury the surface is very rapidly oxidated, and the oxide adheres to both disc and point, which prevents so perfect a metallic contact as that obtained by the spring and break.

To adjust the Intensity Armature.—See that the faces of the iron cylinders, that carry the coils F G, are parallel to, and all but in contact with, the magnetic battery A; if not, unscrew the nut of the multiplying wheel E, and take it off its axis; you then have at your command the four screws against which the battery rests, and by means of them, and the nuts of the strap C C, you can adjust the battery to the greatest nicety. The next step is to adjust the break, so that the spring Q will separate from it just at the same time that the iron cylinders of the armature have left the poles of the magnetic battery; and, lastly, see that the iron wire spring O presses gently against the hollow brass cylinder I.

To give the shock.—Grasp the two brass conductors R S in the hands,*

* If the hands are wetted with vinegar, or salt and water, the effect is considerably increased.

Fig. 2.



put one of their connecting wires into the holes of either of the brass slips M or N, the other wire into the hole at the end of the brass stem that carries the break H. Connect M N by T, turn the multiplying wheel in the direction of the arrow, and a violent shock will be received by the person holding R S. The shock which is obtained from the intensity armature, having 1500 yards of fine insulated wire, is such, that a person, even of the strongest nerves, will not readily volunteer to receive a second shock. Place R S in two separate basins of salt and water, immerse a hand in each basin, and the shock will also be felt very powerfully; this method is to be preferred, as it leaves the person who is electrified the power of quitting when he pleases: not so with the conductors, for the muscles of the arms contract violently, so as to close the hands completely on the conductors, taking away the power of letting them go. If the two connecting wires of R S are put in M N, the shock is not so powerful. The shock can be modified in different ways by turning the wheel E very slowly, or increasing the distance between the battery A and the armature D, or by making the break H separate from the spring Q, when the armature D is horizontal.

U V are a pair of directors, holding a piece of sponge each, to be used when the electricity is to be applied medicinally. The connecting wires are to be placed in the same way as the conductors are in the figure; the sponges must be wetted with a little vinegar, or salt and water, so as to make them conduct the electricity. By those directors a succession of most powerful shocks can be given, when the case requires it; or they can be so modified, as to be barely felt by the most nervous patient.* Remove T from M N, put the two pieces of iron wire with an end of each in its place; put other ends of them into two holes that are in the sides of the battery A; let the wires be sufficiently long to allow the armature to rotate between them. If one wetted finger is placed on the brass stem that carries the break H, and another wetted finger is placed on the magnetic battery, the shock will be also felt. While the machine is so arranged, if you look between the face of the rotating armature and the magnetic battery, vivid flashes of

* To medical gentlemen, the instrument may be strongly recommended, from the following advantages. Its portability; its being always in a fit state for action, even in the dampest weather; the nicety with which the power of the shocks may be increased or diminished. Indeed, it combines the advantages of the electrical machine and the galvanic apparatus, at the same time that it does not labour under the disadvantage of either; for, as has already been stated, it is not affected, like the former, by a moist condition of the atmosphere, nor like the latter, is it necessary to make use of any acids: nay, since the improvement has been effected which is alluded to in the text, even the use of mercury is superseded.

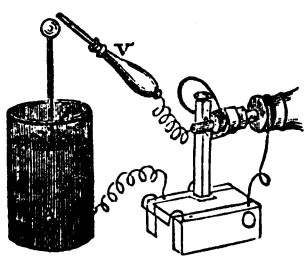
light will be perceived playing between both. This light may also be frequently seen without the wires being in connexion with the battery. Sometimes it will be observed flashing between the coils F G.

The Quantity Armature differs materially from that which is employed for intensity. The latter, as already stated, has two coils of 1500 yards of fine insulated copper wire. The inventor has also tried silver wire, which he found to be superior to copper, in the proportion of nearly 3 to 1. The quantity of iron in the cylinders, also, is much smaller than in the quantity armature, whose effects are greatest when the quantity of iron in the cylinders is increased, and the length of the copper wires diminished; the wire at the same time, for quantity, being much thicker. The quantity armature contains only 40 yards of wire.

To Decompose Water, and obtain its elements in separate vessels, or unmixed, Mr. Clarke employs the arrangement represented in fig. 2. A is a glass vessel, containing two glass tubes. The platina wires are soldered to two pieces of copper wire, and also to the two brass cups *b b*, which are intended to hold a little mercury. Connect by copper wire; a little acid, or any salt, will increase the effect, by forming a better conductor with M N, as in the figure. Here Q must work on the single break H. C D, two platina plates, having two copper wires soldered to them, to connect them with M N; on placing a piece of litmus or turmeric paper between them, previously wetted with some neutral salt, its decomposition is shown by the alteration in the colour of the paper. You may even transpose the colours, by altering the position of the break H.

To charge the Leyden Jar, and deflect the gold leaves of the electroscope.—Twist a piece of copper wire round the outside coating of the Leyden jar, A, fig. 3: connect it with the block of the

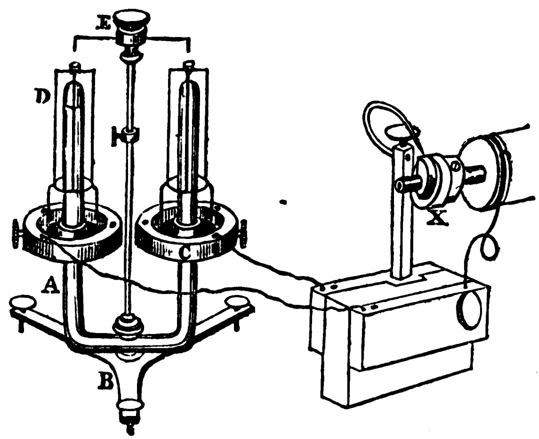
Fig. 3.



magneto-electric machine. Withdraw the sponge from the director V, and connect its wire with the end of the intensity armature, as in the figure. Rotate the armature at a moderate speed; hold the director by the wooden handle, and make it touch the ball for a moment only, as on that depends the success of the experiment, as it is only one spark that shows the fact. Should the director rest on the ball, so as that two or more sparks are obtained from the armature, you fail Bring the ball of the Leyden jar in contact with a delicate gold-leaf electroscope, and the leaves will be diverged. Very little practice will make you perfect in developing their effect. The jar is charged to a very low intensity indeed; but Mr. Clarke has found that, after diverging the gold leaves, if he puts his hand on the electroscope so as to discharge it, and the gold leaves collapse, on touching the electroscope with the ball of the jar, again the leaves diverged with as much energy as before. He again discharged the electroscope, and again produced a divergence: this he repeated thirteen times, with the same effect each time, from the one charge. Mr. Clarke had not time to pursue the experiment further, but would be glad to know to what extent it could be carried. The jar he used was eight inches deep, five and a half inches diameter, open at the top: the tinfoil coatings were six and a half inches deep.

To produce Rotation by Magnetic Electricity.—A, fig. 4, is a vertical horse-shoe magnet, on a tripod stand B; C, improved flood-cups; D, the wire frames, having two little cups at top to hold a drop of mercury; E, a connecting-fork. Mercury being poured into the flood-cups C, and the single break X

Fig. 4.



being used, on placing the connecting-wires as in the figure, continuous rotary motion will be produced by this arrangement, the current being constantly in the same direction. But the experiment may be varied, by substituting the double break H, (fig. 1 front page,) the currents now alternating. A singular fact connected with this experiment is, the rotation of the two wire frames in the same direction, owing to the passages of the electricity from one of the wire frames into one pole of the magnet, and then from the other pole of the magnet down the other frame.

DESCRIPTION OF THE AMERICAN MODE OF MOVING HOUSES.—BY MR. A. J. MASON.

(Concluded from page 224.)

Before quitting the subject of houses of wood, I would mention, that Stow in his "Survey of London," published in 1598, states that his father's house in Throgmorton-street, was loosened from the ground and removed on rollers to a distance of 22 feet, in order to enlarge the garden of Sir Thomas Cromwell, afterwards Earl of Essex, who had built a new house, and had directed his surveyors to take in 22 feet of ground from the gardens of his back neighbours, without their permission or giving them any kind of notice. No one dared complain of this arbitrary conduct of the king's favourite; but Stow, in concluding the account, pithily adds—"so much of my own knowledge have I thought good to note, that the sudden rising of some men causeth them in some matters to forget themselves."

Moving workshops on rollers I have often heard of as being done at Woolwich and elsewhere in this country; but the moving brick houses is a more important affair; and I find, that on that point much incredulity still exists. I have been told by some of my friends, that had I not assured them I had seen such a thing done, they could not have believed it. The truth is, that in late years the operation has been so often performed in New York, that it ceased to excite any very remarkable attention, and I regret, that from familiarity with the sight, I neglected to become so perfectly acquainted with the full details, as I should have been, had I been a practical mechanic, or engineer. I, however, trust that the general description I shall be enabled to give, added to the better understanding of my auditors, may convey some correct idea of the matter. I shall now proceed to the mode of moving brick houses, as the more important part of the business; those of wood, are of course moved in the same manner, but it is then easier to effect.

In the house to be removed holes are made just above the ground, in each of

the end walls, sufficiently large to admit beams, a foot or 15 inches square, as shown in the elevation, fig. 1; these holes are made 3 or 4 feet apart. The beams, A A A A, are inserted, of course, parallel to each other, so as to project about

Fig. 1.

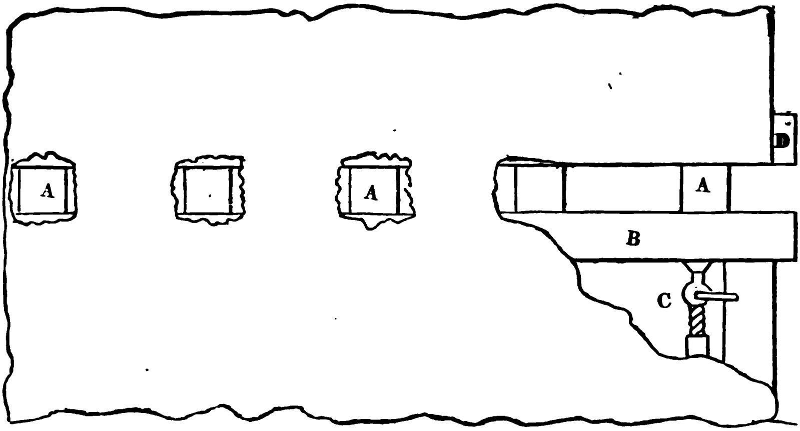
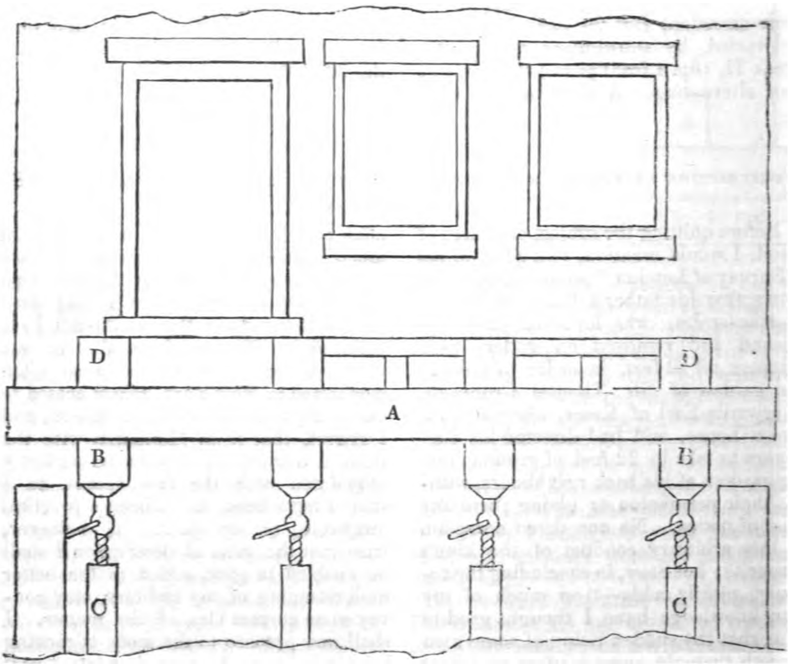


Fig. 2.

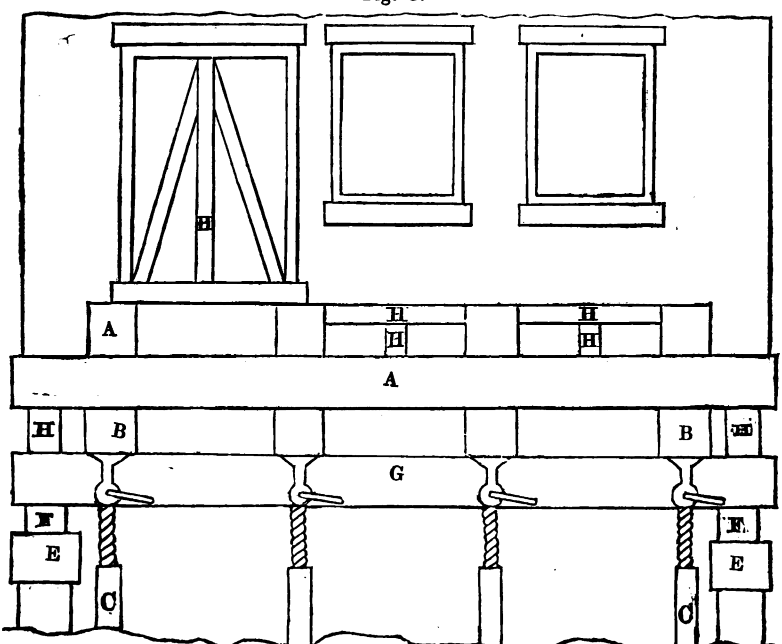


2 feet beyond each wall, and the ends are placed on firm blocks of wood on the ground, clear of the walls, between which blocks and the beams wedges are driven in for the purpose of raising the beams, so that they shall bear up tightly against the upper parts of the holes, and thus, as to use, supply the place of the bricks previously taken away, by sustaining in a great measure the weight of the house;

when this has been done, the foundation of the end walls may be removed, and the intermediate brick work taken away, leaving a clear space for further operation. The same process is then gone through with the front and back walls, beams (B) being inserted across and underneath the first timbers, and resting on blocks outside the walls as in the first set. After this has been done, and the foundation and superfluous brick work cleared away, the two sets of timbers are brought up tightly to each other, by upright screws, C, placed beneath, (as fully shown in fig. 2) by which operation, the blocks placed on the ground under the ends of the beams, are relieved and taken away. Other pieces, as D D, are sometimes inserted above the first set to give extra support to the front of the house.

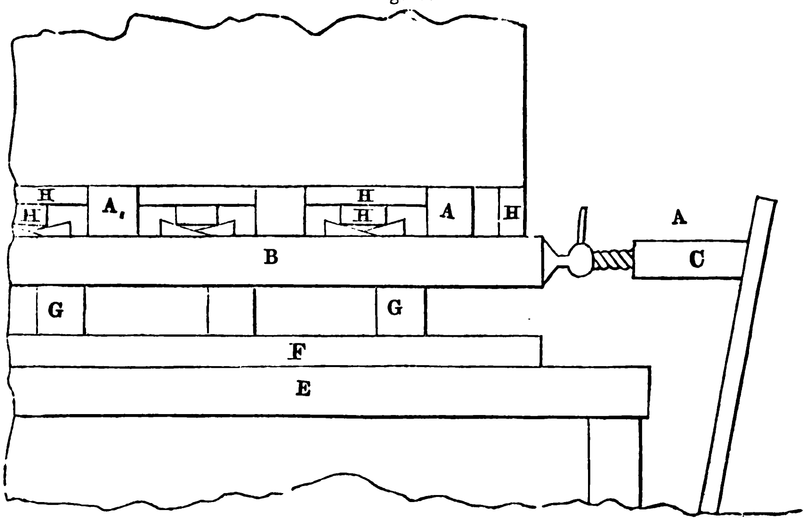
The house now wholly rests on a frame work, sustained by the screws, and the ground beneath can be entirely dug away. It then becomes easy to place transversely, or at upright angles with the first set of timbers A A A, a set of fixed slides, or ways, E E E, as shown in figure 3, which occupy the exact place

Fig. 3.



where the foundations of the end walls had previously stood. Above, and immediately upon these fixed ways, and running in the same direction, it is next necessary to place a set of cradles, F F, similar to those used in ship-yards. Between the cradles and the second set of timbers B B, the beams marked G are inserted, at right angles with both. Extra pieces of wood and wedges, as H H H, are then driven in at various parts to tighten the whole, and to bring finally the entire weight of the building on to the cradles, and consequently, upon the ways on which they rest; so that all the supporting screws can be withdrawn, and transferred to the front as shown in fig. 4. The whole of this complicated frame work, is so firmly bolted and fastened together in every part, that there is no danger of it or the edifice it supports getting deranged. In order that the house may move safely, a deep groove is cut the whole length of one of the fixed slides or ways, into which the cradle immediately above is made to work, by means of a corresponding projection or feather. The cradle and slide

Fig. 4.



being both well greased, the screws are then placed horizontally in the street, so as to press against the cradles, or second layer of timbers; these being made to act all at one time, the cradles, with their burden, move slowly along to the destined spot, propelling the house at the rate of 3 or 4 feet per day. The operations at this stage are fully shown in fig. 4. When arrived at the required place, it remains supported as before, till a new foundation is built to receive it; then, by inverting the process, the timbers are withdrawn one by one, and the house is fixed permanently in its situation, without injury to itself, and frequently without the furniture or inhabitants being disturbed.

A careful examination of the diagrams will enable the description I have attempted to give to be better understood. In this way many houses of brick and wood have been removed; and in 1838, when Fulton-street was widened, a mass of three brick houses, three stories high, were moved back in one body to a distance of 16 feet. Sometimes a building is raised from the ground, and a new story erected beneath; the process is quite similar as regards the timbers and screws, the action only being vertical instead of horizontal.

I have mentioned that the policy in New York is to lower the hills to a level with the other parts. Sometimes a house placed on such an eminence has been too valuable to be sacrificed, and it has then been gradually brought down; the operations being still similar, the application only different. This was the case with the dwelling formerly the residence of the noted Colonel Burr, which was so lowered; it was first converted into a theatre, and is now known as the Richmond Hill Tavern, and is in the upper part of New York. The celebrated Dutch governor, Stuyvesant, immortalized by Knickerbocker, inhabited, for his country seat, a house on the East river; this was surrounded by extensive grounds, the dwelling itself being on an eminence. In extending the city, and pursuing the levelling plan, it was intended to preserve the dwelling by lowering it; but in digging the hill away around it, the brickwork got undermined, and a portion of one corner crumbled away. In this state it existed long after I went to New York, and I often saw it, and engraved a woodcut view of it for one of the American periodicals.* The house was finally entirely pulled down. A stone under St. Mark's church, in the same vicinity, marks where the Dutch hero was buried.

I will mention three curious applica-

* Mr. Mason, the author of this paper, is one of our London school of wood-engravers, and delivered several years ago, at the Royal and other Institutions, a set of lectures on his art, which were much commended at the time for the curious research and artistical judgment which they displayed. He has now returned to pursue his profession once more in London (3, Acton-street, Bagnigge Wells-road), and has our best wishes for his success.—Ed. M. M.

tions of the system of house-moving, and which happening during my residence, I can safely testify to the truth of.

The house inhabited by General Gates at the revolution, situated about two miles from the city, being on an elevated spot, had to be moved in order that the hill might be levelled. It was therefore prepared with the proper timber work as described, and was in that condition when I left America. A new foundation and kitchen story were building at the same time, some few feet distance, on the direct line of one of the new streets; and it was intended to remove the old dwelling on to the new story, which I have since learned was completed according to the plan which I had seen in progress.

Chapel-street, in New York, was widened by order of the corporation; many of the houses were moved back, and some pulled down. At the corner of Chapel and Leonard streets, stood a large and strong brick building, used as a blacksmith's workshop; this lying in the way of the improvements, had to be removed; it was sold by auction, and was purchased very cheaply by a person who owned a small house adjoining it in Leonard-street, with some ground behind it. The speculative purchaser first moved the small house in Leonard-street beyond the extremity of the blacksmith's shop, and turned its front towards Chapel-street; he then moved back the blacksmith's building the required number of feet, and brought it on a level with the small house previously moved. Out of the old workshop he formed three handsome three-story houses, with shops, and made additions to the small house, so that the whole now presents a line of four complete houses, effected by this ingenious mode, at much less expense than by the usual course of building.

In a more recent improvement, Centre-street was widened and extended, in order to join a main thoroughfare by the City Hall. Many houses were pulled down and carried back, as in other instances; but there was one well-built brick house that stood completely across the proposed roadway. There was not sufficient room on either side to receive it wholly; so the ingenious proprietor, rather than sacrifice his house, conceived the idea of dividing it from top to bottom through the three floors; this he actually accomplished, and the two distinct parts were conveyed to opposite sides of the street, in which state I saw them before the chasms in the walls had been filled up. He then perfected them, and they form now two separate, though narrow buildings.

The cost of moving a moderate sized brick dwelling is about 100 dollars, which is considerably less, even with the new brickwork, than the expense of pulling down and rebuilding, besides saving much time. A Mr. Simeon Brown, of New York, was the projector of this peculiar and useful novelty in practical science; he died, I believe, only a few months since.

ON EVAPORATION.

Sir,—Believing that the following remarks will be useful, you will oblige me by inserting them in the *Mechanics' Magazine.*

Whenever air enters liquids, or oleaginous or bituminous matter, the pressure on all sides is so nearly equal, that, from necessity, it assumes a globular form. The pressure gives it that form. The globule is the impress of a law of nature. Whoever will be at the trouble to observe the state of air in water, oil, or any other liquid, whether the air be in large masses or small ones, will perceive that they are always globular; and when the globule emerges, it always comes out enveloped in a film of the matter from which it emerges. Of such globules are vapours composed. All vapours consist of globules of air enveloped in films of liquid, unctuous, or bituminous matter; for the evaporation of liquids and other substances is effected by the issuing of air out of them, which has previously entered either by radiation, or by pressure from accession (which is also called conduction); and the rate of evaporation is proportioned to the accession of air, by the agencies before mentioned, to the evaporating matter; increasing and diminishing with the rate of accession.

Such is steam, or the vapour of water. Such also is smoke, or the vapour of burning matter. So that the end to be attained in the burning of smoke is to ignite the spherules of gas as soon as they emerge from the burning matter; for the instant the spherule is ignited the film of bituminous matter which enveloped it bursts and falls back, and the

gas reunites with the atmosphere, the source from whence it came. When the smoke is collected for the purpose of lumination, another method of separating the gas from the bituminous matter is adopted, which is minutely described in the treatises on gas-light. In that case the separated films produce the sediment termed coal-tar.

The process of artificial evaporation is, to some extent, illustrated by an experiment mentioned in a paper on Vaporization, at page 71, vol. xxxi., of the *Mechanics' Magazine*.

I am, Sir,

Yours, with much respect,

G. WOODHEAD.

Mottram, near Manchester.

MATHEMATICAL DEMONSTRATION OF THE PRINCIPLES OF DREDGE'S PATENT IRON BRIDGES. BY THE INVENTOR.

(Continued from page 215.)

Recurring again to the data as shown in fig. 3, and to equation (10), we obtain for the effect of the oblique thrust in the direction I K. *Oblique thrust in* I K=

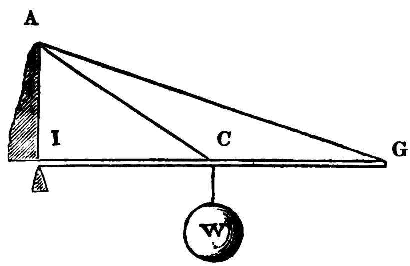
$$\frac{w}{m}\sqrt{(m^2+2\,m\,n+n^2+n^2\cot.^2\phi)} = \frac{100}{40}\sqrt{\{40^2+(2\times20\times40)+20^2+20^2\times2{\cdot}90422\}}$$

But $40^2=2\times20\times40$; hence, by expelling these terms,

$$\textit{Oblique thrust}=\frac{100}{40}\sqrt{+3773{\cdot}776}=2{\cdot}5\times61{\cdot}43=153{\cdot}57\text{ lbs.}$$

So that when the weight is appended to the middle of the lever the oblique thrust is the same as the power required in the cord.

Fig. 5.



It has been shown that the direction of the tensile line does not affect the magnitude of the horizontal thrust, provided all other data remain the same; nor is the pressure at all varied at the fulcrum I, if the lever I G be supported at more points than one, as in (fig. 5), where two tensile lines, A C and A G are applied at the points C and G to sustain it. The pressure throughout the line I G is, however, not the same constant quantity, and for this reason the angles A G I, and A C I, are each less than 90°; hence their cotangents are of some definite value, and that particular part of the weight which each of the cords bears, if drawn into the cotangent of the angles they respectively make with the line I G, will show the horizontal thrust caused by the action of each; and as these two forces both act in the same direction, and in the same lines but applied at different parts of it; it follows, that the portion I C, must resist both, whilst that part, C G, sustains a pressure of only one force, viz., that induced at the extremity G. Then, if w_o and w_1 be put respectively, represent the weights supported at the point C and G, and if $\phi_o = \angle$ A C I.

$$w_1 \cot.\phi = \textit{the pressure in } \text{G C},$$

$$\text{and}\qquad w_1 \cot.\phi + w_o \cot.\phi_o = \textit{the pressure in } \text{C I} = q.$$

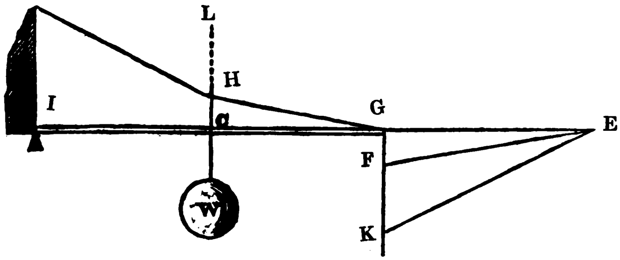
If I C be equal to $\frac{1}{2}$ I G $=\frac{1}{2}m$, the fulcrum I will support $\frac{1}{4}$ of the weight; $\frac{1}{2}$ will be sustained at the point C by the cord A C, and the remaining fourth at the point G by the line A G. Also $\cot.\phi_o=\frac{m}{2\,d}$, and $\cot.\phi=\frac{m}{d}$; hence, if we substitute these values of w_o w_1 $\cot\phi$, and $\cot.\phi_o$, we have

$$\tfrac{1}{4} w \times \frac{m}{d} = \frac{w m}{4 d} = \textit{Pressure in } \mathrm{C\,G} \ldots\ldots\ldots\ldots \quad (11).$$

$$\frac{w m}{4 d} + \left(\tfrac{1}{4} w \times \frac{m}{2 d}\right) = \frac{w m}{2 d} = \tfrac{1}{2} w \cot. \phi = y \textit{ Pressure in } \mathrm{C\,I} \ldots (12).$$

From this it is evident, that neither the arrangement nor the number of the tensile bars can effect any alteration in the magnitude of the horizontal thrust at I; but it is also evident, that by putting more than one cord in an oblique direction to support the weight, the horizontal force is made to vary, viz., to be less at the extremity G, and in the line G C, than it is after the second force is applied at C, and resisted in the line C I. From this we pass on to another condition of the problem, and one which has a direct practical application; it is that where the lever I G, fig. 6, is maintained in equilibrium by the joint action of the cord A H G, and the vertical subsiding force H C, which supports one half the weight at the point C, and is attached to the cord A H G at H.

Fig. 6.



By construction H C is perpendicular with respect to the horizon, therefore, the angle H C I = 90°. Now, the cotangent of 90° = 0; hence, $\tfrac{1}{4} w \times 0 = 0$. Consequently, a vertical subsidiary force cannot produce any pressure in the line C I, nor at the fulcrum I. It is shown, however, by equations (8) and (12), that the horizontal thrust at I, is not at all affected by the arrangement of the suspending bars; therefore, since it is only these bars that are altered in this case, it follows, that the whole amount of pressure, or $\tfrac{1}{2} w \cot. \phi$ must be induced by the forces operating at the point G, that is, by $\tfrac{1}{4} w \cot.$ H G I, so that the cot. H G I is twice as great as cot ϕ; for

$$\tfrac{1}{4} w \cot. \mathrm{H\,G\,I} = \tfrac{1}{2} w \cot. \phi, \text{ or } \cot. \mathrm{H\,C\,I} = 2 \cot. \phi \ldots\ldots \quad (13).$$

According to preceding equations,
Tension in H G = $\tfrac{1}{4} w$ cosec. H G I.
By the calculus of sines, the square of the cosecant of any arc, or angle, is equal to the square of the cotangent, plus the square of the radius, or,

$$\mathrm{cosec.}^2 \,\mathrm{H\,G\,I} = \cot.^2 \mathrm{H\,C\,I} + 1 = 4 \cot.^2 \phi + 1.$$

$$\text{So that, } \tfrac{1}{4} w \,\mathrm{cosec.\,H\,G\,I} = \frac{w}{4} \sqrt{(4 \cot.^2 \phi + 1)} \ldots\ldots \quad (14)$$

The cosecant of H C I, or 90° being equal to unity, it follows that the tension in the line H C, is $(\tfrac{1}{2} w \times 1) = \tfrac{1}{2} w$.

The power required to resist the strain in H A must evidently be equal to the resultant of the tensions in G H and C H; the *equation of condition* representing it therefore is—*Tension in*

$$\mathrm{H\,A} = \sqrt{\left\{\left(\frac{w \,\mathrm{cosec.\,H\,G\,I}}{4}\right)^2 + \left(\frac{w}{2}\right)^2 + 2. \frac{w}{4.} \mathrm{cosec.\ H\ G\ I.} \frac{w}{2} \cos. \mathrm{G\,H\,L}\right\}}$$

Now G H L is the supplemental angle of G H C and the line H C is perpendicular to the horizon; hence,

cos. G H L = sin. H G I.

So, by substituting,
sin. H G I instead of cos. G H L, we get,

$$\textit{Tension in } \mathrm{H\,A} = \sqrt{\left\{\frac{w^2 \operatorname{cosec.}^2 \mathrm{H\,G\,I}}{16} + \frac{w^2}{4} + \frac{u^2}{4} \sin. \mathrm{H\,G\,I} . \operatorname{cosec.} \mathrm{H\,G\,I.}\right\}}$$

But the product of the sine, and cosecant, is equal to rad. consequently,

$$\textit{Tension in } \mathrm{H\,A} = \frac{w}{4} \sqrt{(\operatorname{cosec.}^2 \mathrm{H\,G\,I} + 8)}$$

And if we substitute ($4 \cot.^2 \phi + 1$), instead of cosec.^{2} H G I, it becomes,

$$\textit{Tension in } \mathrm{H\,A} = \frac{w}{4} \sqrt{(4 \cot.^2 \phi + 9)} \;\ldots\ldots\; (15).$$

By which the required power in H A is shown in known quantities. The same result may be obtained thus:

Draw a line G D of any convenient length, and let it represent the weight w. At right angles to it produce G E, of such proportions that:

w : G D : : $\frac{1}{2} w \cot. \phi$: G E.

On G D set off G F and F K, so that G F might be equal to $\frac{1}{4}$, and F K to $\frac{1}{2}$ of the line G D; draw E F, and E K, and they will be the linear representatives of the tensions in the lines G H, and H A.

Now, by construction, D G E is a right angle, hence,

E F^2 = GE^2 + G F^2 and EK^2 = G E^2 + G K^2.

If we substitute the computed values of the lines G E, G F and G K, we have,

$$\mathrm{E\,F}^2 = \sqrt{\left.\frac{w^2 \cot.^2 \phi}{4} + \frac{w^2}{16}\right\}} = \frac{w}{4} \sqrt{(4 \cot.^2 \phi + 1)} \;\ldots\ldots\ldots\; (14).$$
o

$$\mathrm{E\,K} = \sqrt{\left.\frac{w^2 \cot.^2 \phi}{4} + \frac{9\,w^2}{16}\right\}} = \frac{w}{4} \sqrt{(4 \cot.^2 \phi + 9)} \;\ldots\ldots\ldots\; (15).$$
o

Which is precisely the same as shown by equations (14) and (15).

The difference in the lines E K and E F is,

$$\mathrm{E\,K} - \mathrm{E\,F} = \mathrm{H\,A} - \mathrm{G\,H} = \frac{w}{4}\left\{\sqrt{(4 \cot.^2 \phi + 9)} - \sqrt{(4 \cot.^2 \phi + 1)}\right\} \quad (16),$$

and,

$$\tfrac{1}{2}\, w \cot. \phi \div \tfrac{3}{4}\, w = \tfrac{2}{3} \cot. \phi = \tan. \mathrm{H\,A\,I} \;\ldots\ldots\; (17).$$

If an oblique instead of a vertical subsidiary force be used, the difference of tension between the two parts of the cord H A and G H is greater with the former than with the latter.

For, let fig. 7 be a bracket so situate, having the subsidiary force C H inclined to the horizon, and attached, at a known distance A H, from the point A; let the distances I G, I C, &c., and the weight w, be the same as before, the angle H A I will also be the same, but H G I will be greater.

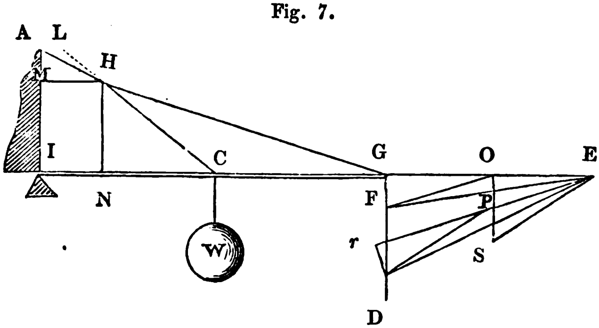
Draw the lines H M and H N, and,

H M = H A sin. H A I = I N

A M = H A cos. H A I,

I M or H N = I A − H A cos. H A I,

Fig. 7.



$$\frac{\mathrm{I\,A} - \mathrm{H\,A} \cos. \mathrm{H\,A\,I}}{\mathrm{I\,G} - \mathrm{I\,N}} = \tan. \mathrm{H\,G\,I} \;\ldots\ldots\ldots\; (18),$$

And,

$$\frac{IA - HA\cos. HAI}{IC - IN} = \tan. HCI \ldots\ldots\ldots (19).$$

Thus the magnitude of the angles H G I and H C I become known.

Put $\rho = \angle HGI$
$\rho_o = \angle HCI.$

The weight supported at the points G and C is the same as before, viz., $\frac{1}{4} w$, and $\frac{1}{2} w$, respectively; then,

Tension in G H $= x_1 = \frac{1}{4} w \operatorname{cosec.} \rho$

Tension in H A $= x_2 = \frac{1}{2} w \operatorname{cosec.} \rho_o$

The pressure or thrust in the line I G is not the same magnitude throughout; for upon the point I, and in C I, it is equal to the joint action of the weight suspended on both points G and C; but in C G it is only equal to that portion which is induced by the action of $\frac{1}{4} w$ sustained at G; thus,

Pressure in G C $= q = \frac{1}{4} w \cot. \rho$

do. C I $= q_2 = \frac{1}{4} w \cot. \rho + \frac{1}{2} w \cot. \rho_o = \frac{1}{2} w \cot. \phi.$

If the value of x_1 and x_2 be shown in the known quantities of the cotangents, then

$$x_1 = \frac{w}{4} \sqrt{(\cot.^2 \rho + 1)} \ldots\ldots (20)$$

$$x_2 = \frac{w}{2} \sqrt{\cot.^2 \rho_o + 1)} \ldots\ldots (21)$$

The magnitude of the force in H A is of course equal to the resultant of the forces x_1 and x_2; therefore,

$$\textit{Tension in } HA = x_3 = \sqrt{x_1^2 + x_2^2 + 2\, x_1 x_2 \cos. GHL)};$$

But cos. G H L = cos. $(\rho_1 + \rho)$, so, by restoring the calculated values of x_1 and x_2, and substituting cos. $(\rho - \rho_o)$ for cos. G H L, we have,

$$x_3 = \sqrt{\left\{ \left(\frac{w}{4} \sqrt{\cot.^2 \rho + 1} \right)^2 + \left(\frac{w}{2} \sqrt{\cot.^2 \rho_o + 1} \right)^2 + \right.}$$

$$\sqrt{\left. 2\, \frac{w}{4} \sqrt{\cot.^2 \rho + 1}\; \frac{w}{2} \sqrt{\cot.^2 \rho_o + 1} \cos \left(\rho_o - \rho \right) \right\}}$$

which by reduction becomes,

$$x_{3} = \frac{w}{4} \sqrt{\left\{ \cot.^2 \rho + 1 + 4\,(\cot.^2 \rho_o + 1 + \cos. (\rho_o - \rho) \sqrt{\cot.^2 \rho + 1}\, (\cot.^2 \rho_o + 1) \right\}} \quad 22$$

and

$$\frac{w}{4} \sqrt{\left\{ \cot.^2 \rho + 1 + 4\,(\cot.^2 \rho_o + 1 + \cos. (\rho_o - \rho) \sqrt{\cot.^2 \rho + 1}\, (\cot.^2 \rho_o + 1) \right\}} -$$

$$\frac{w}{4} \sqrt{(\cot.^2 \rho + 1)} \ldots\ldots (23)$$

is the difference in tension between H A and H G, and consequently the chain or cord must be made to vary its section in that proportion. Now,

$$\frac{w}{4} \sqrt{\left\{ \cot.^2 \rho + 1 + 4\,(\cot.^2 \rho_o + 1 + \cos. (\rho_o - \rho) \sqrt{\cot.^2 \rho + 1}\, (\cot.^2 \rho_o + 1) \right\}} =$$

$$\frac{w}{4} \sqrt{4 \cot.^2 \phi + 9)} \ldots\ldots (24);$$

But,

$$\frac{w}{4} \sqrt{(4 \cot.^2 \phi + 1)} > \frac{w}{4} \sqrt{(\cot.^2 \rho_o + 1)};$$

Therefore,

$$\frac{w}{4} \sqrt{(4 \cot.^2 \phi + 9)} - \frac{w}{4} \sqrt{(4 \cot.^2 \phi + 1)}$$

is less than the difference shown in equation (23). In consequence, however, of

the angles ρ, ρ_o, and ϕ, being of differnt values, the magnitude of one (that is ϕ) being no way deducible from the others, it is necessary, in order satisfactorily to compare the above, to have recourse to the following means.

In fig. 7, draw G D and G E at right angles to each other, and let them be of the same dimensions as G D, G E (fig. 6); divide G D in F, and K, also in the same proportion; and on the line G E, set off G O = G F cot ρ. From the point O erect the perpendicular O S equal to F K, draw the line E S, and it will represent the linear value of the tension in the subsidiary force C H, whilst O F will show the magnitude of it in the lower part of the cord, G H, *i. e.*

$$O F = x_1 = \frac{w}{4} \sqrt{(\cot.^2 \rho + 1)} \ldots (20_o)$$

$$E S = x_2 = \frac{w}{2} \sqrt{(\cot.^2 \rho_o + 1)} \ldots (21_o)$$

Parallel to E S and O F, and from the points K and E, draw the lines K P and E P, until they intersect each other in P, then $E P = O F = \frac{w}{4} \sqrt{\cot.^2 \rho + 1}$, and $K P = E S = \frac{w}{2} \sqrt{\cot.^2 \rho_o + 1}$), also if E P be extended to r, K P r = S E G − F O G = $\rho_o - \rho$. Draw the line E K, and it will be the hypothenuse of the right angled triangle K G E, which by construction has similar angles, and equal sides to the right angled triangle K G E (fig. 6). Therefore,

$$E K = \frac{w}{4} \sqrt{4 \cot.^2 \phi + 9)}$$

But E K also subtends the obtuse angle E P K of the triangle E P K, and by (12 Prop. 2 Book Eu.) it is.—"The square of the side subtending the obtuse angle is greater than the squares of the sides containing the obtuse angle, by twice the rectangle contained by one of the sides about the obtuse angle, and the line intercepted without by a perpendicular to it drawn from the opposite angle." So: $E K^2 = E P^2 + P K^2 + 2 E P P r$; but, $P r = \cos. K P r \times P K, = P K \cos. (\rho - \rho_o)$, and if we substitute the computed values of E P, P K, &c., we have:

$$E K^2 = \left\{\left(\frac{w}{4}\sqrt{\cot^2 \rho + 1}\right)^2 + \left(\frac{w}{2}\sqrt{\cot.^2 \rho_o + 1}\right)^2 + 2.\frac{w}{4}\sqrt{\cot.^2 \rho + 1}\,\frac{w}{2}\sqrt{\cot.^2 \rho_o + 1}\,\cos. (\rho + \rho_o)\right\}.$$

reducing which, it becomes

$$E K \text{ or } \frac{w}{4}\sqrt{4 \cot.^2 \phi + 9)} =$$

$$\frac{w}{4}\sqrt{(\cot.^2 \rho + 1 + 4 (\cot.^2 \rho_o + 1 + \cos. (\rho_o + \rho) \sqrt{\cot.^2 \rho + 1 (\cot.^2 \rho_o + 1)}\}} \quad (22_o)$$

which is the same as the value x_3, equation (22).

It has been said above that

$$\frac{w}{4}\sqrt{4 \cot.^2 \phi + 1)} > \frac{w}{4} \sqrt{\cot.^2 \rho + 1)}$$

and so it is, For, draw the line E F, and, as in fig. 6, it will be the linear representative of $\frac{w}{4}\sqrt{4 \cot.^2 \phi_o + 1)}$, whilst O F is equivalent to $\frac{w}{4}\sqrt{\cot.^2 \rho + 1}$.

Now E O F is an obtuse angled triangle; the obtuse angle E O F being subtended by the line E F, then E F is equivalent

$$\frac{w}{4}\sqrt{(4 \cot.^2 \phi + 1)} = \sqrt{F O^2 + E O^2 + 2 E O. O G} =$$

$$\frac{w}{4}\sqrt{\cot.^2 \rho + 1 + 4 (\cot.^2 \rho_o + \cot. \rho_o \cot. \rho)};$$

so that,

$$\left(\frac{w}{4}\sqrt{(4\cot.^2\phi+1})^2 > \left(\frac{w}{4}\sqrt{(\cot.^2\rho+1)^2} \text{ by } \frac{w}{4}^2 (\cot.^2 \underset{o}{\rho} + \cot. \rho \cot. \dot{\rho}) \quad (24)$$

and, of course,

$$\frac{w}{4}\left\{\sqrt{4\cot.^2\phi+9)} - \sqrt{4\cot.^2\phi+1}\right\} <$$

$$\frac{w}{4}\left\{\sqrt{(\cot.^2\rho+1+4(\cot.^2\underset{o}{\rho}+1+\cos.(\underset{o}{\rho}-\rho)}\ \sqrt{\cot.^2\underset{o}{\rho}+1\,(\cot.^2\rho+1)} - \sqrt{\cot.^2\rho+1}\right\}$$

It therefore follows from this, that the section of the lower part of the cord, H, G, may be reduced to a much less area, when an oblique subsidiary force is used than when a vertical one is applied.

It is not necessary to extend the investigation further, for the law which governs the variation of the tension in the chains is as clearly shown by the action of one subsidiary force, as it would be if extended to many; for in fig. 6,

The square of the tension in G H $= \text{E F}^2 = \text{F G}^2 + \text{E G}^2) = \frac{w^2}{16}(4\cot.^2\phi+1.)$

Do. H A $= \text{EK}^2 = \text{K G}^2 + \text{E G}^2 = \frac{w^2}{16}(4\cot.^2\phi+1;)$

and $(\text{E G}^2+\text{K G}^2) - (\text{E G}^2+\text{F G}^2) = \text{F K}^2 + 2\,\text{E K, F G}$; so that

The tension in G H, or $\frac{w}{4}\sqrt{(4\cot.^2\phi+1)} = \sqrt{(\frac{1}{2}w\cot.\phi)^2+(\frac{1}{4}w)^2}$ . . . (25)

Do. H A, or $\frac{w}{4}\sqrt{(4\cot.^2\phi+9)} = \sqrt{(\frac{1}{2}w\cot.\phi)^2+(\frac{1}{4}w+\frac{1}{2}w)^2}$. (26)

Therefore the square of the tension in H A, exceeds the square of the tension in G H, by the square of the weight supported by the subsidiary force, C H, together with twice the rectangle of that weight by the weight sustained at the point G: and this holds good, no matter what number of subsidiary cords there may be employed to sustain the platform. For instance in the cord A G, fig. 8, where the lever I G is supported by the assistance of ten subsidiary forces, the square of the tension in any link, for instance, in the link *d e*, exceeds the square of the tension in the link *e f*, by the quare of the weight supported by the subsidiary force *e o*, plus twice the rectangle of that weight, by the whole of the weight sustained at the point *f*.

(*To be continued.*)

MR. PILBROW'S NEW "INJET REACTION ROTATORY ENGINE."

[Patent dated May 23, 1842; Specification enrolled November 23, 1842.]

Mr. Pilbrow's name is already familiar to our readers, as that of a very ardent investigator of the properties of steam, and the author of more than one ingenious attempt to improve its application to practical purposes. But all that Mr. Pilbrow has hitherto done in this way—all, indeed, that he and every body else has done—must be considered as cast into the shade by the discovery which forms the subject of his present patent—provided always there be no mistake in the estimate which Mr. Pilbrow has formed of it. After much patient thinking, and much careful experimenting, Mr. Pilbrow has arrived at the startling conclusion, that the present steam-engine, with all its vast pretensions, is but A GRAND PRACTICAL BLUNDER—"in harmony with no motion in the universe, and standing alone, a singular departure from the laws of nature!" The same thinking and experimenting have, however, happily disclosed to Mr. Pilbrow certain novel and extraordinary facts about steam, by which he has been enabled to rectify the Grand Blunder, and to present the world with an engine on a new plan, of which regard for truth will not allow him to predict less, than that it "will entirely supersede those now in use." A curious thing attending this approaching revolution in

mechanics is, that it is stated to depend on a certain law of nature, which, though it escaped the keen scrutiny of Watt, the great master of steam, and of all his numerous followers, (Mr. Pilbrow himself included, till the light of 1842 dawned upon him,) is so "*very simple*," that, "when noticed, the mind immediately recognizes it as a truth in science," and, where all before was discord, sees nought but "harmony well understood"!

As it is not every day that the Chancery Rolls are honoured with such special revelations as the present, Mr. Pilbrow has, he says, departed "somewhat from the usual form of specification;" that is to say, so far as to place on record how it was he came to think of the great discovery in question—how, by a rigid course of philosophical deduction, he gradually developed and established it—and how, the more he reflects upon it the more clearly he sees, in the immediate foreground of the future, the whole existing system of steam practice swept away before it. So we, too, duly impressed with the greatness of the occasion, "depart somewhat" from our "usual" course with respect to the Specifications of Patent Inventions, in thus prominently calling public attention, to the eventful disclosures contained in that of Mr. Pilbrow.

The nature of his present improvements is thus generally enunciated.

"My invention of certain improvements in steam-engines consists in a *new discovery of the properties of Steam*, by which I have ascertained the proper effect or force due to its expansive velocity; namely, that *both the whole available power and extreme duty from expansion, may be obtained from the simple expansive velocity of steam when applied in the peculiar manner hereinafter described*, as well in locomotive as in other high-pressure and condensing engines, on my plan; also in the engine and apparatus by which such discovery is made available for propulsion and general purposes; and in the laws or rules by which the best velocities of my engines are ascertained to give the maximum effect; which improvements combined, form a steam-engine characterized by me, to distinguish its principle from that of all others, as the 'INJET REACTION ROTATORY ENGINE.'"

The history of the "discovery," is next related as follows:—

"Wishing publicly to record the origin of my discovery, I shall depart somewhat from the usual form of specification, believing that the result of my experiments will create a great alteration in the application of steam, and that *my engine will entirely supersede those now in use.* The properties of steam have been hitherto considered of that peculiar nature as to render it impossible to obtain its full power and extreme duty from expansion, except by using it according to the present system, that is, by letting it into a close cylinder on a piston, and stopping its further entrance, by cutting it off to allow it to expand. Feeling, however, a strong conviction that the whole power was to be obtained by some more simple means than the present costly, complicated, and ponderous machine, and that the power so easily raised need not be so laboriously applied, I undertook a long series of experiments to discover how this might be done. I first commenced on the most simple form of engine known to us, that of Hero, and ascertained the true causes of its loss of power, and found after many inventions to obtain by this simple machine the full power and duty from expansion, that though I could considerably increase its power by the form of arm shown in fig. 1 (a serpentine form), yet that I could not obtain the whole duty from expansion, and consequently, that an engine on this principle could never be brought to compete with Mr. Watt's condensing engine. The failure, however, of my plans to obtain these results *disclosed to me the remarkable fact that a current of steam in rapid motion, that is, issuing from an orifice, loses almost entirely that power of lateral expansion which it possesses when cut off and allowed to expand from a state of comparative rest.* When I had confirmed this phenomenon by other experiments, I was satisfied *that steam possessed an impulsive power of the utmost efficiency, entirely different from what had ever been supposed;* for its full expansive force not being given out *laterally* must have gone somewhere, and as it could only expand in the line of its issue, *I became acquainted with this new and singular property of steam, that it possessed* IN ITS MERE VELOCITY ALONE, a propulsive force from its lineal expansibility *equal in power and duty to the gross effect obtained, when cut off* and allowed to expand under the best circumstances."

So far, then, the new discovery is this, that a current of steam issuing from an orifice in a boiler, possesses a power, "in

its mere velocity alone," exclusive of all other sources; so that to the power due to the pressure *within* the boiler, we ought to add the power acquired by the velocity *outside*, which is estimated to be fully equal to the other. And the sufficient reason for all this is stated to be, that the current has little or no *lateral* expansion; and that as its force must "go somewhere," it must of necessity be in a straightforward direction. We believe this to be very unsound doctrine; but deferring till the close what we have to say on this head, we shall proceed with our analysis of the Specification.

The next thing Mr. Pilbrow set about doing was, he says, to find out how "to transmit this new principle of steam power to machinery with the least possible loss from friction and other deductions, by some engine as simple as the principle itself." He first tried how it would answer with a wheel on Hero's plan, the "most simple" of all known steam-engines; to which he was the more induced by the reflection that "it has been considered by all writers on the properties of steam, that it possesses but a feeble power by emission to turn a wheel, in comparison with the quantity expended."

With this wheel as ordinarily constructed, he accomplished no more than has been done before. With a plate placed at a little distance opposite the nozzle or orifice at the end of the arm for the escape of the steam, *but not extending beyond the arm*, the wheel was brought to a stand still; the action of the unbalanced pressure and the reaction of the steam from the plate being equal. But by substituting for the plate a conical-shaped cavity, placed at a certain angle, he obtained the extraordinary results stated in the following extract:—

"If, however, a cavity be fixed, instead of the plate, opposite the orifice, at such an angle, that the injet of steam can be returned by its reaction clear of the arm without impinging thereon, the arm will revolve in the contrary direction to that of the previous unbalanced pressure *with more power than that with which* it revolved the contrary way, previous to the cavity being fixed thereon, *proving that the cavity* not only received the same amount of impingement as the flat plate received, but by this peculiar injet and reaction or re-issue of the steam, its *whole velocity was arrested, and the cavity thus acquired another power of equal amount*, sufficient to overcome and carry round the effect of unbalanced pressure only."

Here, then, was the "simple" means of which Mr. Pilbrow was in search, of turning his discovery of the power "in velocity alone" to account. He had but to *catch it up*, as it were, before it became exhausted,—as one might do a cricket-ball in mid career, and bowl it back into the wicket. And that there may be no mistake as to what his notion is on this head, he afterwards reverts to it in such terms as the following:—

"When I had discovered how this DOUBLE POWER was to be obtained by *arresting and transferring the whole velocity of the steam* by such peculiar injet, and its clear reaction or reissue," &c.

"By this *peculiar* direction of the injet of steam, and its clear reaction or reissue, *about* DOUBLE *the effect* is obtained by its mere impact or impingement against a vane or flat surface, for *all* the velocity of motion, or impulsive momentum of the steam is thus *arrested*," &c.

That there is no mistake about the "DOUBLE EFFECT" so obtained, Mr. Pilbrow holds to be incontrovertibly proved by the following "Table of Pressures," ascertained from "actual experiment."

"The following Table of Pressures will show the proper force of an impulsive effect from the simple expansive velocity of steam rushing on my principle into a stationary cavity unenclosed in the open air of the engine-room. The diameter of the supply-pipe was one inch, and five feet ten inches and a half long with one bend; and at its termination the orifice of discharge was three-eighths of an inch in diameter; or about the ninth of a square inch. The several pressures of steam in the boiler were throughout half a pound more; this half pound being allowed for condensation," &c.

Table of the force of the injet of steam in a stationary cavity unenclosed and exposed to the atmosphere, and its reissue therefrom, calculated upon the square inch from actual experiment, given by an

orifice of about the ninth of a square inch.

Steam above the atmosphere at the orifice of the pipe.	Actual result from an orifice of 3-8ths of an inch diameter.		Effect per sq. inch, from an orifice of a square inch.	
	lbs.	oz.	lbs.	oz.
10	2	3	23	3
20	5	4	41	6
30	7	4	70	0
40	Not tried.		93	3
50	Ditto.		116	6"

We do not think this table by any means so conclusive as Mr. Pilbrow supposes; but, again postponing comment, let us attend to Mr. Pilbrow while he explains how he proposes to make his two discoveries practically available—first, the great or primary discovery, that there is a power "in mere velocity alone," equal to the power from the boiler pressure; and, second, the subordinate, though scarcely less important one, that the whole of this velocity power may be applied to working purposes, by simply reversing its line of direction, when at or near to its maximum point. He gives drawings and descriptions of several machines which may be constructed on these principles, modified according to the particular uses to which they are to be applied, as steam navigation, railway transit, &c.; but it may suffice to describe one of the simplest, which is, a steam wheel after the fashion of that of Hero. The periphery of the wheel is "formed by a series of cavities all round, of the same dimensions," and it is "attached to the nave by spokes, or by a plain disc." "The steam is admitted from the boiler by a pipe sufficiently large to keep fully supplied a circular steam chamber, from which the steam passes along several passages which terminate in nozzles *of the required area*, placed as near to the periphery of the wheel *as they can be, without touching*, and to conform to the circle thereof." It is stated to be "important that each steam way to each nozzle or orifice should be not less than 7 times the area of such orifice." The manner of operation is stated to be as follows:—

"The steam will pass from the steam-chest through the passages, whence it will rush with its full power into the cavities of the wheel, *and the state of its velocity be arrested thereby*. These cavities must be at such an angle, as will permit the steam to reissue therefrom in the opposite direction to its entrance without striking against the back of the cavity next in succession. * * * * * * At starting, and before the wheel has attained its allotted velocity, the wheel *will be exceedingly powerful*. It will not only receive the full effect derived from *the velocity* of the steam, but it will be set in motion by the additional power of the used steam, which will re-issue from the cavities of the wheel, and enter the cavities round the case from which it will be again returned into the cavities of the wheel by action and reaction, and thus be used over and over again, *until the wheel attains* a velocity greater than what remains in the used steam, or until it is thrown off by the action of the wheel, and its centrifugal force through the eduction passages. * * * (He then supposes 60 cubic feet of water to be evaporated per hour, at 60lbs. pressure on the square inch, and thus proceeds:)—Such steam wheel revolving at 34·830 feet a minute,—at about which velocity I prefer the periphery of my engine at such pressure to revolve—will, I *think*, give the actual power of 153 horses, after deducting for loss by the velocity of the steam wheel. * * * And three jets of the united area of 2·37 square inches are sufficient to discharge such quantity of water evaporated into steam per hour."

Mr. Pilbrow adds, that there may of course be any number of jets employed, so that,

"I can thus increase a high-pressure engine on my principle and plan to any power required, from 100 progressively to 1,000 horses, without increasing the size or weight of the engine," &c.!

One more extract, and our readers will have had the pith and marrow of the Specification. It is a sort of summary of the whole, in which Mr. Pilbrow endeavours to set still more clearly before us the master principle of which he has been the fortunate discoverer.

"The principle of my discovery depends for its verification upon a very simple, but universal law of nature, before referred to, and which, when noticed, the mind immediately recognizes as a truth in science, applicable as well to steam as to all other bodies, fluid or solid, independent of its con-

firmation by my experiments. This law is, that all motion is power, *power in proportion to the velocity of motion*, and to the amount of its beneficial transfer to the medium of communicating it. * * * Whatever body has a momentum or motion given to it * * * its force lies only in the line of its direction, in which, and which only, it must give out the same power as *it received;* and to obtain the whole force from bodies so moving, they must be arrested *before any part is lost by distance*, or at that point where the different nature of the body is found to impart its greatest force."

We have attentively considered all that Mr. Pilbrow has thus placed on record respecting his "new discovery;" and, notwithstanding the very confident terms in which he speaks of it, as a thing quite indisputable, and inevitably destined to change the whole face of mechanical science, we do not hesitate to place also on record our firm conviction that there is nothing in it. Indeed, so opposed do we consider it to some of the best established principles—nay, to the very A B C—of mechanical philosophy, that, but for the respect which we entertain for Mr. Pilbrow, whose previous productions have left on our minds a very favourable impression of his talents and attainments, we should have passed it over without note or comment, as one of that perpetual motion class of nihe days' wonders, with which the public are every now and then amused.

To suppose that there can be any power in "mere velocity alone," is most assuredly a grievous mistake. Velocity is but one of the many states or conditions in which matter is exhibited—as rest, position, motion, (of which velocity is a phasis,) suspension, &c. It is of itself, and by itself, literally a nonentity. There is nothing substantive or tangible in it. You can no more lay hold of velocity, (as Mr. Pilbrow proposes,) than you can bottle up obliquity. It signifies simply the time which any body, to which motion is given, takes to pass through a given space. It is an exponent of the amount of force exerted to produce that motion; but neither forms any part of that force, nor adds to it. "All motion," says Mr. Pilbrow, "is power." That is true: but when he adds—"power in proportion to the velocity of the motion," he but substitutes the exponent of the force exerted for the force itself. Ordinarily, cause and effect count for only one; but what Mr. Pilbrow wants to do is, to reckon them as two—the force as 1, and the velocity as 1, =2.

The velocity of water ejected horizontally from a reservoir is well known to be exactly proportional to the head, or pressure of water in the reservoir. So, also, must it be with steam, which is but a fluid of another description. According as is the pressure in the boiler, and the area of the outlet, so will be the velocity of the discharge, or quantity of steam discharged in a given time. Mr. Pilbrow speaks of the "expansive" force of steam as if that had something to do with the independent power which he fancies belongs to velocity. But to expand steam is, notoriously, to weaken its power; that is to say, in proportion as we increase the volume of any given quantity of steam, we diminish the force of each portion of it, separately considered. When we talk of *gaining* by working steam expansively, all that is meant is, that it is worked in that way *more economically*.

But since the *lateral* pressure, says Mr. Pilbrow, of a current of steam in rapid motion, is little or nothing, it must of necessity give out its power in the line of its direction only, and *a greater portion of power*, than if it were allowed to spread in all directions. No doubt the lateral pressure of the column is greatly diminished under such circumstances; but, on the other hand, if the column is not enclosed, then the less the column presses against the atmosphere, the greater will be the pressure of the atmosphere upon the column, and the greater the consequent loss from friction; and if inclosed within a pipe, then in the same ratio that the resistance of a solid body is greater than that of air, will the loss from friction be augmented. It is not true, therefore, that the column gives out its force in the line of its direction *only;* for it parts at every moment with a portion of that force to overcome the obstacles which are opposed

on all sides, and under all circumstances, to its progress.

It follows also, from the fact, that the boiler is the sole source of the power exerted, that that power must diminish in proportion to the distance from the fountain-head, and that the velocity of the column can at no point be so great as at the point of exit from the boiler.

But it is more than untrue, that there is additional power acquired from "the mere velocity" alone, for in point of fact, the greater the velocity the greater must be the waste of power. And the reason is plain; for the greater the velocity the greater must be the friction of the steam against the sides of the various passages which it has to traverse.

The sudden reversal of the course of the steam by the cavities in the periphery of the wheel—the catching of it up "before any part (of the velocity power) is lost by distance," is but another ingenious mode of adding to the loss from friction. No good engineer ever makes a pipe with a bend in it if he can possibly help it; for he knows well that every such obstruction must of necessity require some expenditure of force, more or less, to overcome it.

With respect to the "actual experiments" related by Mr. Pilbrow, we see nothing in them which is not in perfect consonance with the view we take of his "discovery." He passed steam of 10 lbs. pressure through an inch pipe, contracted at the outlet nozzle to $\frac{3}{8}$ths of an inch, and because the observed pressure on the $\frac{3}{8}$ths area was 2 lbs. 3 oz., and this is equal to 23 lbs. 6 oz., or a square inch, "here," he says, "is proof positive of an increase of pressure, and that increase can only be accounted for in my theory of the increase from velocity.' But is not the more obvious cause of this phenomenon the *contraction* of the outlet orifice? It is not difficult to understand how a column of steam, which presses at first equally on an area of a square inch, may, by being concentrated on a portion of that area, be made to press *on that portion* with greater force than before. You may spread a load of hay over a thin sheet of ice without sensibly depressing it; and you may also, by heaping it up at one spot, cause it to break through. It appears to be admitted, and is besides quite certain, that but for the contraction of the orifice there would have been no phenomenon of the sort to be accounted for; but if the contraction be necessary (as it is) to make up for the diminution in the pressure of the steam between the inlet and outlet ends of the discharge pipe, what then becomes of Mr. Pilbrow's supposed increase of power from velocity? To say, as Mr. Pilbrow does, that the 2 lbs. 3 oz. is *equal* to 23 lb. 3 oz. per square inch is saying nothing, unless he could show us also how to obtain that 23 lbs. 3 oz. of square inch pressure by the use of the same, that is of *equal* means. If we must have as many more $\frac{3}{8}$th inch nozzles as are necessary to produce the 23 lbs. 3 oz., and must also increase the supply of steam in the same proportion, where then will be the gain?

But why does Mr. Pilbrow limit himself to $\frac{3}{8}$ths, as the proper degree of contraction? Was he apprehensive that if he carried it any farther the increase of power (according to his formula) would be so great as to render the most credulous a little sceptical? Was he fearful of encountering some such laugh as awaited the stage hero when he exclaimed,

"My wound it is so great, *because it is so small!*"

He only claims credit for doubling the power of the steam and a little more; but it would be easy by the same sort of arithmetical process which he employs to show that he may triple or quadruple it, or indeed multiply it to any degree, within practicable limits, he likes. For example, if instead of contracting the nozzle to $\frac{3}{8}$ths, he contracts it to $\frac{3}{16}$ths he will find, we make no doubt, that the pressure on the $\frac{3}{16}$ths is about double that on the $\frac{3}{8}$ths, or 4 lbs. 6 oz. And then following out his rule, as 3·16 gives 4 lb. 6 oz., so surely must 16·0 give 46 lbs. 6 oz., or a clear gain (by the mere device of narrowing the outlet!) of 36 lbs. 6 oz.

When viewed by themselves apart from all arithmetical glosses (often the most deceiving of any,) Mr. Pilbrow's experiments prove no more than this, that when steam at an initial pressure of 10 lbs. was passed through an inch pipe of 5 ft. 10½. in. long, it was so much weakened at the end of the pipe, that even when concentrated within the narrower compass of ⅜ths inch, it exhibited a pressure of only 2 lbs. 3 oz. And this, though fatal to all Mr. Pilbrow's notions on the subject, is perfectly consistent with every thing which preceding experience has taught us as to the value of steam power when applied under such circumstances.

We have hitherto purposely refrained from saying anything as to the effect which the escape of heat has in producing this great and rapid reduction of power (though no doubt the chief cause) in order that we might bestow our consideration more exclusively on the other points we have been discussing; but it is not unimportant to observe, that even supposing Mr. Pilbrow were right in his theory, that there is a power in "mere velocity alone," and that this is caused by the absence of lateral pressure in currents of steam at high velocities, neither the one thing nor the other could prevent the constant escape of the heat at all points, from the instant of the steam's emission from the boiler. It deserves also Mr. Pilbrow's serious consideration, that there is nothing in his supposed "discovery" or in any of the auxiliary contrivances which he has described, to prevent the great additional absorption of heat which must unavoidably take place when the steam, after leaving the nozzle or nozzles, comes into contact with the cold air that will rush in along with it into the cavities of the wheel, with the cavities and surfaces of the wheel itself, and with the condensed vapour, which must speedily accumulate in the cavities. Mr. Pilbrow directs that the nozzles shall be brought as close as possible to the periphery of the wheel, "without touching;" but what interstice would be too small to prevent air to a most destructive extent rushing in?

Mr. Pilbrow says that after all, he does not expect to do more work than is already accomplished by the Cornish engines. Now, considering that the Cornish engines are the slowest in the world, and that Mr. Pilbrow's "discovery" consists in doubling the power of steam by velocity, this must be regarded as rather a remarkable admission. Does it not, indeed, render it superfluous to say a word more on the subject? More, at least, we will not say, than this, that it will be a strange thing to us, should Mr. Pilbrow, with his steam power destroying mode of applying steam—all others excelling in that respect alone—ever reach within a great many degrees of the slow, but sure performances of the Cornish engineers.

MR. CRADDOCK'S STEAM-ENGINE IMPROVEMENTS.

Sir,—I shall be obliged by your correction of two or three errors in the account of my improvements in the steam-engine inserted in your last Number. At page 187, column 1, line 4 from bottom, "an area of 8 square inches," should have been "an area of 38 square inches," and at page 188, column 1, line 8, "the large piston," should have been "the small piston."

There are two or three considerations in connexion with my mode of using steam, that were not touched on in my last communication, to which with your permission I will now call the attention of your readers. It has been suggested to me by some parties, that the original cost of my engine may be an objection to its introduction. To this I reply, that I believe it will not be greater in its original cost than any other condensing engine of equal power, and that in all those situations (and they are not few) where water for the non-condensing engine can only be procured through the Water Works, or through some equally expensive channel, the saving that will be effected in this item alone by the use of my engine will be equal to 15 per cent. on its extra cost. In large towns does not my invention afford a ready means of getting rid of the steam after it has done its duty in the engine, and at the same time returning the water to the boiler? In situations where room is an object, the condenser may be placed on the top of the building; and not only is room thereby economized, but a greater condensing effect is

produced by the more free access of air. To show that such a situation may be chosen with advantage, I will observe, that my first condenser was thus situated, and that it has worked more than twelve months without requiring any other attention than an occasional packing of the stuffing-boxes, which from the peculiar nature of the motion of the parts is only needed once in three or four months.

I am not unaware, Mr. Editor, of the difficulty of drawing attention to improvements in a machine like the steam-engine, and the prejudice with which such improvements are generally received; and I cannot hope that my efforts to improve the mode of using steam will escape the objections and prejudices that have attended all similar attempts; but I may hope that a consideration of the following remarks may tend to obtain for my exertions a somewhat impartial consideration. In principle I have attempted nothing new; but I have sought to carry out and extend known principles by means which are new, and which I believe to be effectual. The steam-engine is based on a few simple principles; and all that we can hope to do in its improvement is in the mode of carrying out those principles. The first of these was the application of the expansive property of steam above the atmosphere; the next was the extension of this expansive property by the removal of the atmosphere, and the condensation of the steam by cold water; and my improvements consist in carrying out the latter principle under circumstances, and in situations where condensation by water is impossible. I make these remarks, for the purpose of bringing the question into as narrow a space as possible; for if it be granted that the idea of condensing with water was an extension of the expansive principle of steam, it follows of necessity that its condensation by air, combined with nearly as good a vacuum, and that by the consumption of as little power in the engine itself, is also an extension of the expansive principle; an extension which carries the advantages of the condensing engine into situations where previously they could not be realized.

It is obvious that my condenser may be applied to the ventilation or warming of manufactories or buildings, and that too without any additional consumption of fuel; for the heat by which the water was converted into steam, is again given out to the air in condensing; and the warm air may be introduced into the building by either of the following ways; first, by placing the condenser at some lower point than that at which the rooms to be warmed are situated, or by placing the condenser itself in the rooms. By the latter mode the temperature may be readily raised to 100° or 120° as I have found by experiment. For distilling purposes it is also available as well as for the cooling of worts; and the latter it would effect without the evaporation produced by passing a current of air over it; in short, since it is applicable to the condensation of steam, it is evidently also applicable to all cases of cooling, where water has hitherto been applied. As a means of warming, it would give an agreeable diffusion of heat through the apartments.

I am, Sir, &c., &c.,
THOMAS CRADDOCK.

350, Coventry-road, Birmingham.

P.S.—I would observe that the power of the engine as indicated in the table by the gauges, comes out much greater than that deduced from the quantity of water raised; this is owing to the pumps having been made square, and of boards which were not sufficiently strong to resist altogether the atmospheric pressure; for during the working of the pumps, the sides were observed to collapse; this induced great friction, and thereby rendered the pumps less correct as a test than the gauges.

MESSRS. BURY AND CO.'S FOUR-WHEEL LOCOMOTIVES.

Sir,—Your correspondent, the "Practical Engineer," asserts, (pp. 202, 203,) that the engines of Messrs. Bury and Co., on the London and Birmingham Railway, consume more coke per mile, per carriage, than those on the Liverpool and Manchester. He also says that, on the Grand Junction Railway, one engine is employed to draw a train of equal weight, and at an equal speed, to one which on the London and Birmingham requires two engines. Now, the accompanying Tables (see next page,) will show the opposite to be the case on the Grand Junction; and, from some tables in Pambour's Treatise on the Locomotive Engine, (pp. 312, 313,) I find the average quantity of coke consumed on the Liverpool and Manchester to be about the same as on the Birmingham, though in no case does it average so low as ·29 lbs. per ton per mile, as in the annexed tables. The "Practical Engineer" says, also, that, in his opinion, Messrs. Bury and Co.'s inside frame is very defective in point of durability. Perhaps he will give his reasons for thinking so, and show the advantage of the heavy outside frame of wood.

I remain your obedient servant,
J. G. S.

Experiments on the Grand Junction Line.

Name of engine.		Gross load. Tons.	Mean speed. Miles.	Coke consumed. Per mile in lbs.	Coke consumed. Per ton per mile.
Phalaris	May 30, 31, June 1, July 5	59·2	23·05	37·03	·62
Prometheus	June 5, ,, 6, ,, 7, ,, 8	56·7	22·53	34·3	·60
Prometheus	June 11, ,, 12, ,, 13	52·8	22·30	41·9	·79
Phalaris	June 14, ,, 15, ,, 16	62·6	22·08	38·5	·61

Experiments on the London and Birmingham Line.

Description of engines.	Gross load in tons.	Mean rates.	Coke per ton per mile.
12-inch cylinders and 5-feet wheels	50·15	30·51	·47
	70·95	28·53	·4
	81·61	21·85	·35
12-inch cylinders and 5-feet wheels	50·77	31·29	·55
	69·76	29·82	·41
	83·53	19·42	·29

THE WATER POWER OF GREAT BRITAIN.

[From an exceedingly valuable and interesting pamphlet, by Mr. J. Bailey Denton, just published, entitled—"The Question, What can be done for British Agriculture? Answered."]

In estimating numerically, in any known measures, the average quantity of water which rises from the earth in vapour, descends upon it in rain, or exists in the atmosphere, there are imperfections in the data, and other difficulties, which reduce the conclusions to mere approximations; and even as such they are far from satisfactory, though, so far as observation and experience have gone, there is some agreement between them and the theories.

According to the calculations, the average quantity of water suspended in the atmosphere, if it were all precipitated to the surface of the land and sea, would amount to four inches in depth, or 11,794 cubic miles of water. This is greatest at the equator, being about 8½ inches, while at the poles it is only about 1½; in the average latitude of Britain it is about 2½ inches. The quantity of rain which falls would follow the same law, if it were not that different surfaces do not equally supply the same evaporating power. The average annual depth of rain for Britain, according to the experiments of Dr. Dalton and others, may be taken at 30 inches. This supplies all the springs, and all the water which works on the surface of the earth, including streams and rivers, and their floods; and the quantity discharged annually into the sea is estimated at about 13 inches depth in the year, but here it will be no great error if, for the sake of simplifying the calculation, it is taken at 12 inches, or four-tenths of the average fall of rain.* The surface of the British islands, in round numbers, as already hinted, is 77,000,000 acres, and, at the average given, it would be easy to calculate the quantity of water which falls upon it during any given time. If, however, the power of this water is sought, a smaller, but indefinite breadth of land must be taken, because there are some places which discharge no water, and others where it cannot be rendered available as a power. Say that the total breadth, in all the lands in Britain from which it is available, is 50,000,000, and that for England and Wales 20,000,000; and, making allowance for waste, one foot in depth of water over each

* Prize Essays of the Highland Society, vol. vi. —On the Construction of Reservoirs of Water for Agricultural Purposes. By Messrs. James Adam and Findlater.

The depth of 12 inches is quoted, without acknowledging that it is correct: it is believed to be much more.

of these is a power, whether it can be turned to account or no.

The first gives 2,178,000,000,000 cubic feet of water; and the second, 871,200,000,000 cubic feet.

To reduce these, or either of them, into horse-power, there is this datum, according to the ordinary estimates: about 37½, say 38 cubic feet of water, falling every minute on an overshot wheel of 10 feet diameter, is reckoned the power of one horse. Divide each of these numbers by 525,960, the minutes in a year, and the first is the cubic feet for all Britain in each minute, and the second the same for England and Wales. Divide, again, by 38, and the results are the horse-power, that for the whole islands being a constant power of 108,973, and that for England, 43,590. This, however, supposes the water-power to be only on a ten-feet wheel, and that wheel to be in motion every minute of the year.

But in no one instance will such be the case. 12 hours in the day will be the utmost length of working, and ⅛th of the year will suffice for ordinary farm work, and this gives 12 times the above number, or 523,080 horse-power. But this is supposing only a single ten-feet fall; and every additional ten feet doubles the power. Say that the average of falls, one with another, in England and Wales, is 50 feet, and the total horse-power working, as above stated, will be upwards of 2,000,000. This is for the surface water alone; and if the floods were conserved in tanks and reservoirs, judiciously placed, and of proper size, this power would be increased, and a great saving of alluvial matter effected; but there are no satisfactory data for calculating the amount.*

Then for the water which will be obtained by general drainage over and above the quantity which escapes from the lands, there are absolutely no data whatever, for that must depend on the breadth of land which is drained, and the quantity of water afforded by the subsoil springs. It has been calculated that, where the land before draining is very moist, the drainage water will irrigate, in a proper manner, one-fifth as much water meadow as the land drained.† But this is too much for the average of England, and we must not allow more than one-eighth, and perhaps one-tenth would be nearer the truth.

The usual estimate is, that 10,000,000 of the 12,000,000 acres of arable land in England and Wales require drainage; and in order to carry the system of irrigation as far up the hills as possible, 10,000,000 more out of the residue, and which require draining, would be added to that amount. All this could not be done in a year, or probably in a century; but it is a result which could be aimed at, and therefore it may be kept in view. Water sufficient to irrigate about 20 acres would, on a wheel 20 feet in diameter, give one horse power; and if we divide by this, the 2,000,000 acres, irrigated by the drain water of 20,000,000 acres, it would give us a power of 100,000 horse power, upon a single fall of 20 feet. But when tanks and reservoirs are used, the last, if there are more than one, should be made to answer as mill-ponds. During heavy rain this would retain the flood water and the substances with which it was charged, and thus conserving both the fertilizing and the mechanical power in those places where they might be most advantageously applied.

What have been stated are only approximations; but the principles are sound, and it may be of advantage to those who wish to study the subject, and profit by studying it, to have the outline of all its advantages before them. The next inquiry will be into the nature of the substances by which water should be impregnated for irrigation, and also the increase of manures for cultivated land that might be obtained by preserving the sewerage and refuse of towns.

THE HOT-BLAST PATENT.

House of Lords, Monday, March 6.

Before the Lord Chancellor *and Lords* Brougham *and* Campbell.

Househill Coal and Mining Company v. Neilson and others.

The appellants in this case were the defendants in an action tried before the Court of Session in Scotland, for an alleged infringement by them of the hot-blast patent; when a verdict was found against them (see *Mechanics' Magazine*, No. 976, p. 334); and came now before the House of Lords on a Bill of Exceptions, tendered by them against the charge of the learned judge (Lord Justice Clerk), who presided at the trial.

The Lord Chancellor: My lords, the principal question in this case arises out of the eleventh exception. The learned judge (who presided on the trial) stated to the jury what he considered to be sufficient evidence

* The alluvial soil deposited by the waters of the Nile, according to Mr. Rennel, is 14,784,000 solid feet per hour; and by the Ganges, 2,509,056,000 solid feet per hour.

The Mississippi deposits 8,000,000 solid feet per hour; and the Koangho, according to Barrow, carries into the sea 2,000,000 solid feet of sediment every hour.

† See page 34 of the 4th Report of the Commissioners on the nature and extent of the bogs in Ireland.

to support prior use so as to invalidate the patent. The learned judge expressed himself in these terms:—He says "You will observe that it is settled that the trials founded on as a proof of prior use must have been public—must have been continued, not abandoned—must have continued to the time when the patent was granted—I do not say to the very exact period, but it must have been known and used as a useful thing at the time." (After some observations on the meaning of the word "trials" as used by the presiding judge in the jury court, the Lord Chancellor continued—I understand the proposition of the learned judge to be this—that if the machine had been made, and had been put in trial, unless those trials had gone on, and the machines had been used up to the time of the granting of the letters patent, it would not be evidence of prior use so as to invalidate the letters patent. Now, I am obliged to say, with all deference to the learned judge, and with all respect to the learned judges of the Court of Session, that I think in that respect they are mistaken, and that if it is proved distinctly that a machine of the same kind was in existence, and was in public use; that is, if use, or if trials, had been made of it in the eye, and in the presence of the public, it is not necessary that it should come down to the time when the patent was granted. If it was discontinued, still that is sufficient evidence in support of the prior use so as to invalidate the letters patent. If it is discontinued, provided it has been once in public use, and the recollection of it has not been altogether lost—if it has been once publicly used, it will be sufficient to invalidate the letters patent, although the use may be discontinued at the time when the letters patent were granted. Now, my lords, I apprehend that that is the law, and the known law, upon the subject in this country. I never heard it before questioned that the notorious public use of the invention before the granting of letters patent, though it may have been discontinued, is sufficient to invalidate the letters patent. Then, my lords, the remaining question for consideration is this, and it is an important one, whether, if the learned judge laid down the law incorrectly to the jury, this was calculated to mislead the jury? (His lordship then explains how it was calculated to mislead, and says)—Therefore, it is perfectly obvious, that, if the learned judge be incorrect in the manner in which he stated the law, in the particular in which I have stated, it was calculated to mislead the jury. Under these circumstances, my lords, I should recommend your lordships to allow the eleventh exception, and to disallow all the rest.

Lord Brougham: My lords, I entirely agree in the view taken, and for the reason so luminously expressed by my noble and learned friend on the woolsack. If we are of opinion, first, that the law has been mistaken, and under a misapprehension of it, it has been erroneously delivered by the judge to the jury; and if we are, secondly, of opinion that the misdirection in point of law, the mistake in point of law, committed by the learned judge, had a direct tendency, I may almost say an inevitable tendency, to mislead the jury in the conclusion to which they should come, and in the verdict which they should deliver; then, my lords, both of these questions being answered in the affirmative, that the law was mistaken, and that the mistake tended to mislead the jury in their verdict, we have no choice, but must allow the exception. Now, my lords, a more important mistake in point of law, your lordships will give me leave to say, could not possibly have been made by the learned judge, than that into which the learned judge fell upon the present occasion. And I will not allow it to be said for one moment, in dealing with this question, that there is anything doubtful, that there is anything speculative, that there is any new law to be laid down, or even any new topics in respect of the law about to be broached here, in dealing with the direction of the learned judge; for I speak with all possible respect for that learned judge's great ability and experience in his profession in Scotland, when I say, that this law which has been mistaken here by his lordship, is a matter of as perfect certainty, as thoroughly known, and as little drawn into doubt in Westminster Hall, where the law is administered touching the construction of the statute of James, the Patent Act, as any one branch of the law most commonly known, and most frequently administered by our courts. It is one of the greatest errors that can be committed, in point of law, to say that, with respect to such an invention as that, it signifies one rush whether it was completely abandoned, or whether it was continued to be used down to the very date of the test of the patent, provided it was invented and publicly used at the time, twenty or thirty, or as, in this case, forty years ago, it is perfectly immaterial. There being, in my apprehension, no kind of doubt that the jury would say—"Why should we consider whether it was used at the Bradley Works or not? Why should we consider whether it was a trial or a completed invention? Be it so that it was used forty years ago—be it so that it was a complete invention, we hear the learned Lord Justice-Clerk telling us that we need not trouble ourselves upon these facts, for it

is enough for us if it was abandoned, and that takes the facts out of the case, and leads us to find a verdict the other way." Upon these grounds, my lords, we have no choice in this application, it being a bill of exceptions; we have no hesitation in saying that the law was misconceived, and misstated to the jury. The law is undeniable, it is a matter of no doubt or hesitation with any man in this country who has been accustomed to administer it, or I will venture to say with any practitioner whose opinion is entititled to any weight, and I am also of opinion that the law so laid down tended to mislead, and must necessarily have tended to mislead the jury. Upon these grounds I have no hesitation in supporting the proposition of my noble and learned friend, that the eleventh exception must be allowed.

Lord Campbell: The only question is this, whether this misdirection shall be considered as immaterial? When I look at the form of the issue I cannot say that it was immaterial, because the issue is "whether the invention, as described in the said letters patent and specification, is the original invention of the pursuer." Now you cannot say that it was the original invention of the pursuer within the meaning of the issue, if it had been publicly known and practised by others before the patent was granted. It has been said that there was no evidence; but I think that is a mistake—what conclusion the jury have come to I know not—but at the Bradley Iron-Works there was such a machine, as Mr. Rutherfurd acknowledged at the bar, as would have amounted to an infraction of the patent if the use of it had been subsequent to the patent. Then, that being so, I know not what conclusion the jury may have arrived at. They might have thought that this was a perfect machine, that it was the same machine, and that it had been publicly used. If they had been of that opinion, although it had been abandoned, they ought to have found a verdict for the defendant. Under the circumstances, I regret exceedingly that I am obliged to concur in the opinion that has been expressed by my noble and learned friends, that this eleventh exception must be allowed, and the consequence of that will be, that there must be a *venire facias de novo*, and that the case must be tried by another jury.

MR. DAVIDSON'S ELECTRO-MAGNETIC EXHIBITION.

We have pleasure in directing attention to the interesting electro-magnetic exhibition of Mr. Davidson, at the Egyptian Hall, Piccadilly. The problem of producing motive power by electro-magnetism has for some time occupied the attention of scientific men, and considerable advances have been made, both in this country and in Russia, towards the practical application of the effects produced by the galvanic battery. Professor Jacobi has propelled a boat, containing twelve men, by electro-magnetic power. The earlier attempts to render the phenomena of electro-magnetism practically available, were based on the principle of reversal of polarity, or of alternate attraction and repulsion by the positive and negative poles. It has, however, been discovered, that a much greater amount of motive power can be derived from the same battery by taking advantage of the following phenomenon. When the galvanic current is conveyed ronnd a bar of iron by means of a coil of wire, the iron is found to be strongly magnetised, and again to lose its magnetism as soon as the current is cut off. So instantaneous is this effect, that an electro-magnet of this description may be successively magnetised and de-magnetised as many times in the course of a minute as the electric current may be produced or destroyed by the completion or interruption of the galvanic circuit.

Keeping this phenomenon in view, it is not difficult to imagine its application to mechanical purposes. A mass of iron may be moved backwards and forwards, like the piston of a steam-engine, between two powerful electro-magnets; or a wheel, with iron armatures secured in its circumference, may be set in rapid motion by the alternate attraction of two powerful electro-magnets, properly adjusted.

The simplicity and elegance of the electro-magnetic engine afford reasonable ground for expectation that it may hereafter, to some extent, supersede the steam-engine. The only difficulty at present remaining to be surmounted, is in the arrangement of the battery, (which corresponds to the *boiler* of the steam-engine,) and which, in the present state of chemical science, involves more expense in producing a given amount of power, than would be sufficient to evaporate an equivalent quantity of steam. In some cases, however, even at present, where power is wanted occasionally throughout the day, the electro-magnetic engine may be advantageously used, as it possesses the great advantage of costing nothing, except when actually at work, and incurs no waste of expenditure similar to that of getting up and keeping up steam.

Mr. Davidson exhibits the action of several model engines, which work a printing-press, a circular saw, and a small locomotive. One of the most elegant arrangements that

we have seen for some time, is a telegraph which he has invented, worked on the same principle as the engines. With the ingenious electro-magnetic telegraph of Messrs. Cook and Wheatstone the public are acquainted, through its employment on the Blackwall and Great Western Railways. In that apparatus, the signals are given by means of needles, and a code of signals is necessary to conduct or to understand the operation. On Mr. Davidson's plan, the letters of the alphabet are marked on keys similar to those of a pianoforte; and immediately on touching a letter at one station, the same letter is lifted out of a small box at the other. The utility and beauty of a system which can thus give nearly all the advantages of conversation, with an interval of tens of miles between the interlocutors, need no comment. We understand that the principle of the engine and the telegraph is protected by patent.—*Patriot.*

[We have not yet been able to pay a visit to Mr. Davidson's Exhibition, but from all we hear of it, we are disposed to concur most heartily in our contemporary's recommendation of it to the notice of the curious in scientific matters.—Ed. M. M]

EWBANK'S BOOK OF HYDRAULICS—MR. WALKER'S WATER-ELEVATOR.

Sir,—In consequence of your notice of Ewbank on Hydraulic Machinery, I was induced to purchase the work, and found it quite realize the expectations I had formed of it from the perusal of your paper. It is not only a compendium of the principal devices that have been employed in raising water, but it is a history of the progress of civilization and the arts. The zeal and fervour of the author, in his favourite studies, have given the glow of romance to a narrative of facts, and the colouring of poetry to the details of science.

There appears to be nothing on the subject of hydraulics that has escaped his researches, if we except a late invention of our countryman, Mr. John Walker, of Crooked-lane, London, the knowledge of which could not have crossed the Atlantic when Mr. Ewbank's book was published, or he would not have neglected to mention so novel and so simple an apparatus for raising water.

About twelve months ago, the attention of your readers was directed by Mr. Baddeley to Walker's extraordinary hydraulic machines. After giving us statements, to which we could scarcely give credence, he promised to favour us with the results of further experiments, and to report the progress that might be made in applying these machines to important purposes. If reports are correct, Mr. Baddeley is sadly in arrear with a communication which cannot fail to be interesting to your readers.

I am, dear Sir,

Yours respectfully,

John Wright.

Reading, March 17th, 1843.

BAROMETERS—THE DISPUTED STATEMENT OF DR. LARDNER.—(SEE NO. 1016, P. 53.

Sir,—In default of better authority, I will, with your permission, endeavour to remove the doubts of N. N. L., (in your No. 1016,) as to the correctness of the fact stated in his quotation from Dr. Lardner. But perhaps it may be necessary to premise, that as there are at all times amongst your numerous readers a great number of juvenile searchers after scientific truth, it will be advisable for me to give a more familiar illustration than would be required, were I addressing myself individually to the ingenious and intelligent correspondent referred to.

Now, in the first place, let us suppose that we could liquify iron in its cold state; then, as its specific gravity is little more than half that of mercury, the Torricellian tube would exhibit a column of liquid iron approaching to double the height of that which quicksilver presents to our observation. If we were to put the two liquid metals together in the same tube, the column would be higher than that of mercury, in proportion to the quantity of iron used. This granted, I do not apprehend that a doubt will be entertained as to the fact of solid iron producing the same effect.

We may, with more show of reason, I imagine, question the propriety of the scientific doctor's assertion, that the "iron float *assists* the atmospheric pressure," &c.; seeing that the same effect must take place, whichever surface of the mercury bears the ball.

The consideration of this question has suggested to my mind, whether or not a useful modification of the common barometer might not be constructed, with a solid rod of iron or steel floating in the mercury, say fourteen inches in length, and of a thickness sufficient to keep it steady within the glass tube; with the exposed part of the iron rod graduated as a vernier. The range would be somewhat greater than that which mercury alone indicates, yet should not exhibit more than three divisions, and be called inches, as at present.

I am, &c.,

John Crowther.

Broseley, March 14, 1843.

THE NATIONAL DEBT IN SACKS OF SOVEREIGNS.

Sir,—Having in a former communication shown the number of sovereigns it will take to fill an imperial bushel, I will now, with your kind permission, state a case wherein such a mode of calculation might be adopted with advantage; and by way of elucidating some of the mysteries of our venerable friend, Francis Moore, at the same time, let us take "DCCC mil." from his hieroglyphic, A.D. 1843.

Then imagine sixty sacks of sovereigns, all standing in a row, with four bushels in each sack. Next imagine sixty more such rows to fill up the solid square, and although we shall have sixty times sixty coomb sacks all full of sovereigns! it would still require several sackfuls more (35 +) to neutralize the burden upon the old man's back.

There are few readers of the *Mechanics' Magazine* that cannot fully appreciate the value of high numbers; it is to the uneducated classes the above statement would be much more intelligible than the double ellipse, (8,) with its attendant train of eight single ones.

J. Loose.

Wolverton, West Lynn, Dec. 12, 1842.

[The "old man," with "the burden on his back," of our sage friend Moore, is manifestly typical of that patient and enduring old gentleman, known over the world by the name of "John Bull," and his National Debt. Ed. M. M.]

THE SERAPHINE.

Sir,—A communication appeared in your excellent Magazine some little time back, on the making of tongues for Seraphines, by Mr. N. S. Heineken, and speaking of a scale of sizes he had adopted, that gentleman said that should it be of any service, he would forward it to you for insertion. Being in present want of such a scale, and totally unable to obtain one, never having seen a seraphine in this part of the country, it will most likely afford me the means of constructing one without the endless course of experiments, which proceeding in the dark would require, if Mr. Heineker, or any of your correspondents, will oblige me with a scale which they have found to answer, through the medium of your pages.

Yours respectfully,
Henry Smith.

Sunderland, March 2, 1843.

RUNNING OF CANDLES.—A QUERY.

Sir,—Can any of your ingenious correspondents explain a phenomenon which may be observed to the best advantage in good wax candles, though it may also be seen in common moulds. It is this. When the wax has been melted by the flame, and a small pool of fluid wax is forming previous to the candle "running," there may be seen two rapid currents, an upper and an under one, the upper one radiating from the wick, the under one tending towards the wick. If a few light black specks from the snuff are in the fluid, they appear rapidly attracted and repelled by the wick.

Yours, &c.,
C. E. K.

THE NEW COMET.

(*Sir J. F. W. Herschel to the Times.*)

Sir,—I wish to direct the attention of your astronomical readers to the fact, which I think hardly admits of a doubt, of a comet of enormous magnitude being in the course of its progress through our system, and at present not far from its perihelion. Its tail, for such I cannot doubt it to be, was conspicuously visible, both last night and the night before, as a vivid luminous streak, commencing close beneath the stars kappa and lambda (κ and λ) Leporis, and thence stretching obliquely westwards and downwards, between gamma and delta (γ and δ) Eridani, till lost in the vapours of the horizon. The direction of it, prolonged on a celestial globe, passes precisely through the place of the Sun in the ecliptic at the present time, a circumstance which appears conclusive as to its cometic nature.

As the portion of the tail actually visible on Friday evening was fully 30 degrees in length, and the head must have been beneath the horizon, which would add at least 25 degrees to the length, it is evident that, if really a comet, it is one of first-rate magnitude; and if it be not one, it is some phenomenon beyond the Earth's atmosphere of a nature even yet more remarkable.

I have the honour to be, Sir,
Your obedient servant,
J. F. W. Herschel.

Collingwood, March 19.

8 p.m., March 19.—The tail of the comet, for such it must now assuredly be, is again visible, though much obscured by haze, and holding very nearly the same position.

(*Sir James South to the Times.*)

Sir,—The brilliant train of light of which notice is given in *The Times* of this day was seen here on Friday evening at a little after 7, and had very much the appearance of the

tail of the comet of 1811. Its highest point, when I first saw it, nearly reached theta Leporis, and passing through the constellation Eridanus, became invisible to me from interposed trees when about 2 degrees from the horizon. More than 45 degrees of tail were measurable; stars of the 5th magnitude were visible through it by the naked eye, and with a 42-inch achromatic of 2¾ inches aperture, those even of the 8th were perceptible. At 7h. 33m. 28 sec. (sidereal time) a bright meteor issued from the very tip of the tail.

No trace of the above light could be detected here either Saturday, Sunday, or Monday nights, in consequence of cloudy weather.

This evening (Tuesday), at about 10 minutes before 8, the clouds cleared away; but no vestige of the train could be perceived in the neighbourhood which it had illumined on Friday night; but a diffused and amorphous light, commencing at the Pleiades, and spreading over the entire constellation Aries, even through the haze, was too conspicuous to escape observation.

If this be the tail of the comet, it indicates a very rapid motion of it northward.

By a letter which I received yesterday from Mr. Shorts, of Christchurch, Hampshire, he has seen it earlier than any one I have yet heard of, inasmuch as he observed it three nights previous to the date of his letter, which is the 19th inst.; hence he saw it Thursday, Friday, and Saturday.

J. South.

Observatory, Kensington, Tuesday, 11 at night, March 21.

(*Ed. Cooper, Esq., to Sir James South.*)

Nice Maritime, March 14, 1843, evening.

"My dear Sir James,—I beg to give you the following information relative to a new and very fine comet:—

"On Sunday evening last (the 12th), at about a quarter past 7, my servant called my attention to a white line of light which he had just observed near the western horizon. It was like a narrow thin cloud of the description commonly called cirrostratus, one end being apparently merged in the remaining solar light, and the other in or near the constellation Lepus. There were very few clouds in the sky, and none near to this phenomenon. Last night, at about the same hour, my servant again informed me of the reappearance of the light which he had observed on the preceding evening. I found it in a direction parallel to the line joining *eta* Leporis with *gamma* Eridani, and that its apparent upper edge was rather below this line, and consequently that it was nearly parallel with the equator. On watching it as long as the light of the moon permitted me to see it, I found that it set with the stars.

"This evening I prepared my comet-seeker, a large one lately received from Mr. Ertel, and mounted equatorially, in the hope of seeing it again, and of detecting its nucleus. I subjoin my notes of this evening.

"Yours ever very faithfully,

"Edward Cooper.

"March 14.—Mean time at Nice, 7 hours 40 minutes.—I have just lost the nucleus near the horizon. I found it by sweeping down the line of light. It appeared thus in my little Harris's telescope with an object-glass of two inches diameter—[this diagram it would not be easy to copy in print—S]. The star near it I should guess to be about the sixth magnitude; a cypress-tree unfortunately impeded my view of it with my comet-seeker, which is provided with a micrometer, and, consequently, I could not ascertain its place. I fancy it to have been in or near the eastern limit of the constellation Cetus, probably *tau* Ceti or *tau* Eridani. The nucleus is stellar, and apparently about the 6th magnitude. The coma visible in the little telescope is of small diameter, no doubt much affected by the strong lunar light. *Gamma* Eridani is *in* the tail to-night, a little higher than midway. I estimate the visible tail as somewhat longer than the distance between Procyon and Rigel, or about 45 degrees. I did not see the nucleus for a sufficient time to be able to state the direction of its motion, but I fancy it is retrograde.

"Edward Cooper."

(*Sir J. F. W. Herschel to the Times.*)

Sir,—Last night being cloudy, the tail of the comet was not visible here. To-night it is very bright: its direction and breadth are as before, but, perhaps, some trifle curved, the convexity being upwards. Be that as it may, the line of the well-defined part, or *axis*, of the tail has evidently advanced northwards, and passes nearly through, but still a little below *iota* (ι) Leporis: also its extremity has advanced in right ascension, and seems now to extend as far as he intermediate point between kappa (κ) Orionis, and ζ (zeta), or, perhaps, even η (eta) Leporis. The probability, therefore, is, that we shall soon see the head.

I am, Sir, your obedient servant,

J. F. W. Herschel.

Collingwood, March 21.

(*Mr. Q. Harris to the Times.*)

Sir,—I perceive that Herschel mentions a comet. I yesterday received a letter from Oporto, dated the 14th inst., which mentions that a splendid comet becomes visible there

at sunset, appearing in the west, and that it disappears in the west at night. Perhaps you will mention this in your columns, and if you think proper to send it Dr. Herschel, pray do so.

I am, Sir, yours, &c.

QUARLES HARRIS.

9, Billiter-square, March 21,

(*From a Passenger by the last West India Mail Steamer "Tay."*)

An extraordinary phenomenon was observed from the Tay to the W. and SSW. during the homeward passage on the 6th, 7th, 8th, 9th, 10th, 14th, 15th, and 17th inst. In appearance it was like a bright sunbeam, resembling in shape a comet's tail, but more parallel, the altitude of the upper limb being about 32 degrees, and terminating downward about 8 degrees above the horizon in an oblique direction; it was generally visible from half-past 6 o'clock until 9 o'clock in the evening.

(*From Report by M. Arago to the Academy of Sciences.*)

"The comet was observed for the first time on the evening of the 17th instant, owing to the state of the atmosphere, shortly after sunset, towards the SS.W., although it had been already seen at Aussonne, as early as the 14th. Its focus was only visible at our observatory on the 18th and 19th. It then occupied the constellation of Orion. The presence of the moon on the horizon permitted our viewing the star only for a short time, and the observations made were not sufficiently complete to enable the astronomers to collect all the necessary elements, and determine its orbit. Its most striking feature is, the extraordinary length and slenderness of its tail, which presents itself under the form of a long white band. This luminous appendage occupies a space in the heavens, which cannot be less than 41 or 42 degrees, although its apparent breadth does not exceed 1 degree 15 to 20 minutes. Comets, however, have been seen with tails still longer but not so slender. This appendage generally ends with two luminous lines, between which is an obscure space; a disposition that has induced a belief that the tails of comets were luminous cones internally empty. In the present instance the contrary is the case, the light being visibly more intense in the centre than on the sides. The *geocentric* movement of the star is towards the north."

M. Arago then draws a curious parallel between a certain number of comets, which were remarkable for the extent of their tails. He cited, among others, the following instances:—

The comet of 1811 had a tail of an apparent length of 23 degrees. That of 1744, observed by Cheseaux, at Lausanne, was remarkable for its multiple tail, composed of six divergent branches, embracing an extent of 44 degrees in width, and some of which had an absolute length of 13,000,000 of leagues. That of 1789 presented a tail of an apparent length of 68 degrees, whose inflected form, according to the historians of the time, resembled that of a Turkish scimitar, a similarity observable at the extremity of the present comet, but in a far inferior degree. The tail of the comet of 1780 had an apparent extent of 90 degrees and an absolute extent of 41,000,000 of leagues. Finally, the comet of 1818 made its appearance with an appendage so out of all proportion that it covered a space of not less than 104 degrees. Its head was still under the horizon, when the extremity of the tail had already reached the height of the zenith.

M. Arago, on examining the new comet with the polariscope, found its light redder than the zodiacal light, but without the least affinity with the polarised light.

RAILWAY TRAVELLING.

From the Report of the Officers of the Railway Department of the Board of Trade, for the last year (1842) it appears that the total number of passengers by railway during the year, was about nineteen millions; of whom in round numbers, 18 per cent. travelled by first class carriages, 50 per cent. by second class, and 32 per cent. by third class. The number of accidents (not including those which happened to individuals through their own carelessness) was only ten; of deaths, five; of injury to person, 14. As compared with 1841, this shows a diminution of close on two-thirds in the accidents, four-fifths in the deaths, and four-fifths in the cases of injury to person. During the same period, the gross receipts amounted to 2,731,687*l.* from passengers, and 1,010,885*l.* from goods.

HOLLOW AXLES—NOT NEW.

Sir,—Mr. York's hollow axle, though patented (!) is certainly not new, by a century or two at least. Galileo, the first, I believe, who examined mathematically the resistance of solids to fracture—has shown that a hollow cylinder will present the most resistance, and that the resistance will be greater in the transverse direction according as the hollow part is greater. He shows further, that the resistance of the hollow cylinder will be to that of the solid one, as

the whole radius of the hollow is to that of the solid. Thus, the resistance of a hollow cylinder having as much vacuity as solid, will be to the resistance of a solid one, as $\sqrt{2}$ to 1, or as 1·141 to 1·000; for the radius of the former will be $\sqrt{2}$, while that of the latter is unity. The resistance of a hollow cylinder, having *twice* as much vacuity as solid will be to a solid one as $\sqrt{3}$ to 1, or as 1·73 to 1·00 for the radii will be in the ratio of $\sqrt{3}$ to 1. The resistance of a hollow cylinder of which only one-twentieth part is solid will be to that of an entirely solid cylinder of the same dimensions as $\sqrt{21}$ to 1 or as 4·31 to 1·00, and so forth. I am, Sir, &c.,

MATHEMATICUS.

TESSELATED PAVEMENTS.

Prosser's Process of Manufacturing the Tesseræ.

At a late Evening Meeting of the Society of Arts, Mr. Blashfield described the new material for tesselated pavements, and explained practically the process of constructing the same. The Roman tesselated pavements, described by Vitruvius, specimens of which are still in the British Museum, are coloured marbles of various kinds, and of different degrees of compactness and durability. Three years ago Mr. Prosser discovered that by subjecting a mixture of pulverized felspar and fine clay to a strong pressure between steel dies, the powder was compressed into about one-fourth of its bulk, and became a compact body, much harder and considerably less porous than the common porcelain. The first application of this discovery was to the manufacture of buttons, which are more durable and less expensive than those in ordinary use. One of the principal uses to which this invention is applied, is that of constructing tesseræ for pavements. The machine for making these tesseræ is very simple; a vertical screw, worked by a horizontal handle, twenty-four inches in length, is furnished with a steel die at the bottom, of the same shape as the intended tesseræ; immediately below this die is a cavity formed in the bed of the machine 1⅛ inch in depth, and corresponding with the die which works into it. The cavity being filled with the powder, in as dry a state as possible, pressure is applied by turning the handle of the screw rapidly round; and the bulk of powder is thus reduced in thickness from 1⅛ inch to three tenths of an inch. Each tessera, when formed, is raised from the bottom of the cavity by a moveable bed or die, worked by a vertical rod attached to a treadle. When removed from the press, the tesseræ are placed in an oven to undergo the process of baking. These tesseræ will bear a pressure of forty tons, and have been put to the most severe test in respect to the effect of frost on them, having been immersed in boiling water and then exposed to a temperature of 32°. They may also be exposed to a considerable degree of heat, so that flues may be constructed below the tesselated pavements thus formed without causing any injury to them. Blue and green colouring is effected by metallic oxides in the process of baking, but other colours are mixed up before being submitted to pressure. Compact and durable bricks are also made by a similar process, but subjected, of course, to a much greater pressure, which is effected by the use of the hydraulic press. Slabs of elaborate design, and inlaid with coloured devices, suitable for chimney-pieces, &c., are also made by this process, being submitted to a pressure of 250 tons before baking. The subject was illustrated by specimens; and several tesseræ were made by the machine and distributed among the members of the society.

NOTES AND NOTICES.

Liquid Blue.—Mr. J. Futzsche has communicated to the Imperial Academy a method of preparing indigo blue in the moist way, by pouring hot alcohol and a very concentrated solution of caustic soda on equal quantities of pulverized indigo of commerce, and grape sugar, contained in a flask. The ingredients are to be well shaken together, the flask is then to be filled with alcohol, corked and placed aside for a few hours. The clear contents are then to be decanted into a larger vessel, and to remain a few days loosely covered; when the oxidation will be complete, and the indigo blue will have separated in laminar crystals.—*Chem. Gaz.*

The Art of Glass Staining.—The increased use made of stained glass in England is exceedingly gratifying, and the excellent specimens which have been prepared lately show clearly, as the writer has on many other occasions asserted, that we could produce stained glass quite equal to anything that was done by our forefathers if proper encouragement were afforded to the professors of the art. Difficult of attainment, expensive in its processes, so much so, indeed, as almost to prevent experimentalizing except for actual commissions, and labouring under the weight of an erroneous opinion that the art was lost, glass-painting had remained for a long time in a very languishing condition. Latterly, however, it has revived considerably, and many large works in various parts of the country are now in progress. The opinion entertained of our want of skill in glass-painting is hardly yet removed. The author of "A few words to Church Builders," says, "stained glass is of much importance in giving a chastened and solemn effect to a church. Those who travel on the Continent might find many opportunities of procuring from desecrated churches, at a very trifling expense, many fragments which would be superior to any we can now make. But if it be modern, let us at least imitate the designs, if we cannot attain to the richness of hues which our ancestors possessed." Against the opinion to be inferred from this, we will venture to place our feeble protest. There is much old stained glass to be found on the Continent inferior to what we can now make, and there is not

a great deal which we could not equal if the proper opportunity were afforded. Moreover, we do not believe there are any hues possessed by our forefathers which could not now be produced.—*Mr. Geo. Godwin—Civ. Eng. and Arch. Journal.*

Improvement in Iron Boats.—We notice in the Pittsburgh (U. S.) papers, that an improvement has been made in the construction of Iron Boats, intending to render them safe from accident, of which the following explanations may not be uninteresting. The vessel being built in the ordinary manner, an inner lining is introduced between the ribs, and fastened to them by screw bolts or rivets. This lining is from two to three inches apart from the outer covering, thereby rendering the spaces between the ribs, a complete set of iron boxes. As the inner sheathing is made water tight as well as the outer, however much the outer may be damaged the inner will still keep the vessel safe, and as the leak can only extend to the space between the rib or ribs, immediately injured, a great amount of damage outside would cause but a small leakage. The lining being attached to the upraised limb or flanch of the iron rib, before it can be injured, the ribs must be torn apart, but to sunder them seems next to impossible, from the substantial manner in which they are held to their places, by the inner lining; but even should any partial damage occur, the bolts being easily got at any leakage could be quickly stopped. At a comparatively small expense, a vessel is rendered by this combination, a great deal stronger than one built in the old manner. Bulkheads are entirely dispensed with, leaving the run of the ship perfectly clear, an affair in itself of great importance to a ship of war, where room for manœuvring and the health of a large crew is indispensable. It is added that the Government steamer, now on the stocks at Pittsburgh, is to be supplied with this lining, and that when finished she will be the handsomest, strongest, and safest iron boat afloat.

Immense Iron Bars.—The *Merthyr Guardian* gives an account of an extraordinarily large bar of iron, which was lately cast at the Dowlais Iron Works. The pile, weighing about 3000 lbs., after being sufficiently heated, was taken to the hammer and shaped into a bloom; it was reheated, and drawn a second time under the hammer, after which it was again heated (for the third time), and worked in the rolls to a round bar, eight inches in diameter, and about fourteen feet long. A correspondent of the same paper mentions as something still more remarkable, a cable bolt which has been since cast at the Cyfarthfa Iron Works. The pile, weighing about 26 cwt., was, after being properly heated, taken out of the heating furnace and put at once into the rolls, and, in the short space of twenty minutes, came out a perfect bar, about six and a half inches diameter, nearly twenty-seven feet in length, and as "straight as a line."

Death from Stoves.—In all cases of death from stoves, Leblanc has found there was more or less carbonic acid in the air. He has observed even one per cent. of this gas to destroy an animal in two minutes—a fact which explains many of the circumstances which appeared some years ago in the evidence of some London chemists, respecting the influence of Joyce's stoves. It is quite obvious that their structure was dangerous. Leblanc found that a candle was extinguished in air containing only from 4½ to 6 per cent. of carbonic acid. In such an atmosphere life may be kept up for some time, but respiration is oppressive. Even 3 per cent. in the atmosphere killed birds; and yet we have seen statements which affirmed that upwards of 3 per cent. had been detected in the London theatres.—*Trans. Glasgow Phil. Soc.*

Casella's Improved Rain Gauge consists of a hollow cylindrical vessel, 23 inches high and 3 inches and 7-12ths in diameter, mounted upon a hollow base, forming the segment of a cone, whose lower diameter is 13 inches, upper diameter 3 inches and 7-12ths, and height 8 inches. This may be filled with dry sand, or other substance, to give steadiness to the apparatus. It is furnished with three pointed legs, for the purpose of fixing it into the ground. At the top of the vertical cylinder is an open basin, of the same form and size as the base, perforated in the bottom with an aperture equal to one twelfth of an inch in diameter, through which the rain collected in the basin descends to the bottom of the cylinder, and the height of the column of water so collected is shown by a graduated glass tube attached to the cylinder, and communicating therewith at bottom. The tube is half an inch in diameter internally, and the graduation of the tube is in inches and tenths of an inch. The collective areas of the cylinder and glass tube being equal to one-tenth of the area of the basin at top, a scale is readily formed for ascertaining the depth of rain fallen on the surface of the earth in a given time. The mode of adjusting the pluviameter before using it is merely to fill the cylinder with water, usually up to zero, on the side.—*Athenæum.*

Application of Manual Power to Railway Locomotives.—Mr. Tate, contractor for keeping the rails and road of the Grand Junction Railway in repair, has constructed a machine which does not weigh more than about 4 cwt., by which two men can, for a short time, convey it, themselves, and four men as passengers, at a speed of from twenty to twenty-five miles per hour; and, at half that speed, I have no doubt, they would carry three times that number. A little boy, not more than seven or eight years old, propelled the machine, from a state of rest to a speed of from three to four miles per hour, with myself and another person on it, weighing together, I imagine, not less than 7 cwt.! Mr. Tate is of opinion that when labour is cheap, and under peculiar circumstances, manual labour may be even cheaper than horses or steam, especially where speed is required. The machine alluded to was made to accommodate the workmen, &c., on the line, and Mr. T. informed me that, with two men, he has gone over fifteen miles of the line, stopping at twelve different points, within the hour. It is well known that a horse, on a good railway, will draw at least fifty passengers at the rate of twelve miles per hour; assume, therefore, that eight men shall be equal to one good horse (allowing 20 or 25 per cent. for friction of machinery, &c., we shall then still have a power equal to the horse), and, as that number exceeds the usual average number of each train on the Greenwich Railway, is there anything to prevent six sets, or gangs, of men performing 112 trips per day—viz., every quarter of an hour each way, for fourteen hours; fifty persons each trip, or 5600 per day? and, if so, and able-bodied men can be procured at 2s. per day, then manual power will be cheaper than horses or steam, as this would only amount to about 1s. per trip, or about one farthing each for the whole distance of nearly four miles, or less than the sixteenth of a penny per mile!! *Mr. Thos. Motley.—Mining Journal.*

Erratum.—The Self-Registering Barometer and Readman's Improved Barometer.—In the letter of W. M. G., No. 1018, p. 110, col. 1, line 4, for *system* read *cistern.*

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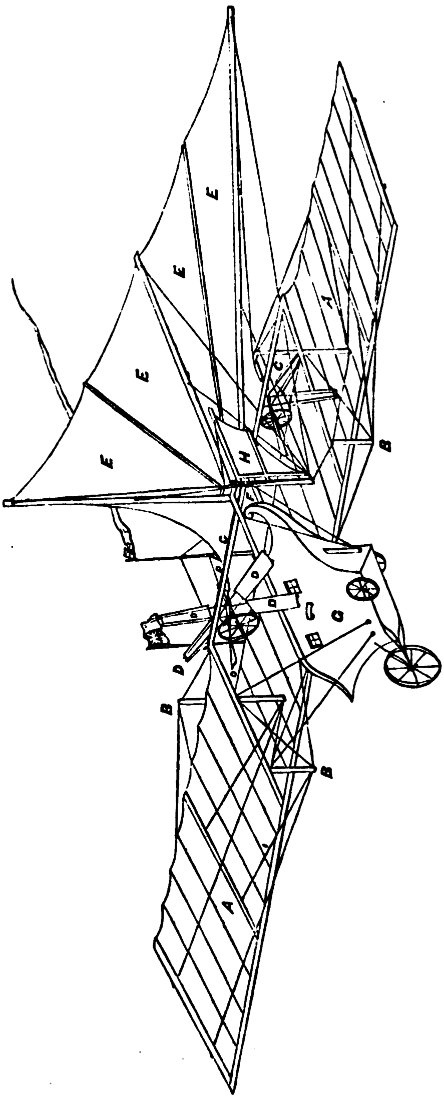


HENSON'S AERIAL CARRIAGE.

HENSON'S AERIAL CARRIAGE.

(Patent dated September 29, 1842; Specification enrolled March 29, 1843.)

[For the *Mechanics' Magazine.*]

We have taken the earliest possible opportunity of examining the specification of this wonderfully well-heralded invention, and now propose to lay before our readers the results of that examination, and of our cogitations upon it.

We may confess, at the outset, that we were of the number of those who looked on the announcement, that Mr. Henson had constructed a machine that would fly, with great incredulity—an incredulity, however, arising rather from a recollection of the many previous attempts of the like kind, and the miserable uniformity of their failure, than from any want of faith in the resources of science and art, to achieve even greater triumphs. Considering that mechanical flying, though not unfrequently assayed, has never yet lifted men above the surface of their terrestrial home, and that even the more novel and successful balloon has never yet been turned to any practical account for purposes of transport, it cannot be deemed wonderful, that even hopeful and well-informed persons should have been inclined rather to deride the pretensions of this new adventurer than to encourage his attempts. In all probability, if he had contented himself with demonstrating on paper, however clearly, that his machine, if constructed, would really travel through the air, he would have met with but little attention; but he went so far, of himself, as to construct models of no inconsiderable magnitude, and these, we are told, exhibited capabilities so striking and unexpected, that wealthy and influential parties were thereby induced to encourage and support him, and to apply to Parliament for an Act of Incorporation, the better to enable them to carry their views into effect.*

The results, scientific, political, and social, which must follow the success of such an invention are obviously of the most momentous character; but at present we advert to them no further than to say, that they have induced us to give all the attention to the present attempt which the very brief period that has elapsed since the enrolment of the specification would permit.

The principal part of Mr. Henson's machine, consists of a frame (A A, prefixed figure) of not less than 150 feet long, by 30 feet wide, covered with silk or linen, and constructed so as to combine extreme lightness with the requisite strength. In the middle of the length of this frame, and immediately beneath it, are a steam-engine and car (G). Attached to the middle of its hinder edge is a tail (E) of 50 feet long, and beneath this is a small vertical rudder (H), or "second tail." These caudal appendages are governed by cords led into the car, and are intended to direct the flight. A small vertical web, extending across the main frame from back to front, and directly over the car and engine, seems designed to diminish lateral oscillation. The entire area of the supporting surfaces is about 4,500 square feet.

So far we apprehend our readers will see nothing to make the machine fly; especially as we have to add, that this gigantic frame, though really serving as wings, is jointless and rigid. It still remains to put the machine in motion, and to keep it in motion by means within itself—the last being the grand difficulty, which has deterred by far the greater number of those who have thought on the subject, and defeated such as have been sanguine enough to try to reduce their plans to practice.

It is in diminishing, if not altogether destroying this difficulty, that Mr. Henson's talent has chiefly, but by no means exclusively, shown itself. His device for the purpose is as follows. The machine, loaded and prepared for flight, is to be placed at the top of an inclined plane, in descending which it is expected it will acquire such a velocity as will produce a sufficient amount of pneumatic resistance on its under surface to sustain the weight of the whole. It is the chief office of the embarked steam-engine to counteract that decay of the acquired velocity, which the resistance of the air to the forward flight will necessarily produce, and this it effects by giving rapid motion to two sets of vanes or propellers (D D), like windmill sails, situated at the back edge of the wings, or main frame: each set consists of six vanes, and each vane is ten feet long. Since the power sufficient to maintain the velocity against the resistance of the air is but a small part of that which would be

* Mr. Roebuck moved for leave to bring in the bill on the 24th instant.

necessary to sustain the machine, it is calculated that Mr. H. thus gets rid of the necessity of carrying more than a small part of the weight of machinery, fuel, and water, which he would otherwise require.

Our readers will see at once that this separation of the starting from the maintaining power is the main feature of the invention, and is perhaps the only mode in which the inherent difficulties of the subject could be avoided—until at least we have command of processes much more prolific of power in proportion to the weight of their requisite apparatus than any with which we are at present acquainted. Notwithstanding all that Mr. Henson has most ingeniously done to diminish the weight of his engine (which we shall describe by-and-by,) we apprehend it is on this device or to the adoption of some of the many equivalent modes of obtaining the initial velocity, independently of the embarked power that his hopes of success must chiefly rest.

Fundamental therefore as is this principle, it is important to see that it is no untrustworthy fancy or baseless novelty; to win our confidence it ought to correspond exactly with known appearances and results. Happily for this momentous art just struggling into being, here is no difficulty. In the case of a clock, the power which first draws the pendulum aside to set it a-going is really that by which the clock continues to go: the weight, or spring, restores continually the continually occurring decline of the original velocity. Just so, the power by which the aerial carriage will be sustained, will be really that which gives it the necessary velocity at first; the steam-engine will merely make good the loss as it occurs; that is, if we suppose the flight to remain unvaried in elevation and speed. Again, a steamboat moves at first slowly and heavily under the whole power of the engine; we continue to urge the application of the power until a speed is attained, at which it is fully occupied in counteracting the resistance of the water. The first office of the engine, that of giving velocity to the boat is essentially different from the last, that of just overcoming the resistance by which that velocity would otherwise be destroyed. If we had been contented with a lower speed, we might have greatly relaxed the efforts of the engine as soon as it was attained, and if the engine had consisted of two parts, one of which was sufficient to overcome the resistance at the intended velocity, the other (theoretically speaking) might have been stationary, and have pushed on the boat till that velocity was obtained. The vessel goes by the speed given her by the supposed stationary engine; she continues to go because the engine on board just balances the retarding force of the water. The same remark applies to locomotive railway engines. Mr. Henson closely follows out the analogy; he sets his machine a-going by its descent down the inclined plane, and he keeps it going by the engine he embarks in the carriage.

This conclusion is the more to be relied on, since it accounts for much which seems puzzling in the flight of birds. A large and heavy crow may be seen sailing "in mid air" on a summer's day, slowly circling amongst his companions, scarcely moving his wings for many seconds together. Since it is not imagined that the law of gravitation is suspended in his favour, the wonder is how he keeps himself from falling. But if the same bird be observed closely when he rises from the ground, it will be seen, that in commencing his flight, he makes great, and sometimes even violent efforts with his wings until he has acquired the needful horizontal velocity; then his strokes become slow and easy, and if he had been so constituted, he might, as far as uniform flight is concerned, leave behind him much of his muscular weight and strength. When, therefore, he is easily wheeling over our heads, he is doing so, not by power applied at that instant, but by that which he exerted when he gained his original velocity—its decay having been constantly repaired by the gentle efforts he subsequently made. A hawk hovering without progressive motion, above a spot in search of prey, can only maintain his elevation by rapid strokes; but as soon as he takes an onward flight, his violent efforts cease, and the beats of his wings become slow, long, and gentle. Nature however furnishes a still closer likeness to Mr. Henson's device. A large bird on taking its flight from a high tree or rock, will often save himself the severe labour of the start, by first making a descent; he thus gains a velocity which brings into due play the resistance of the air, and he easily rises and improves his speed by his subsequent and gradual ex-

ertions. Now this is exactly the course proposed by Mr. Henson.

In all this, ingenious and highly important as is its application to the present purpose, there is nothing which does not follow at once from the first principles of mechanical science. A body once in motion will continue to move for ever if but opposing forces be taken away. To take them away and to countervail them are the same thing. Mr. Henson starts his machine, and then merely countervails the resistance.

The questions still remain, What is the resistance? And will his engine be able to countervail it? Before answering these let us first see what his engine is.

The boiler, which combines in a remarkable degree, lightness with evaporative power, consists of nearly 50 inverted truncated hollow cones, from 30 to 36 inches long, and whose larger and smaller diameters are $4\frac{1}{2}$ inches, and 1 inch respectively. These are placed around and above the fire, to the direct action of which they present about 50 square feet, the total heated surface being at least double that amount. If this surface be only as productive of steam as the average of that of locomotive engines,—that is, if it evaporate 18 pounds per square foot, per hour, under a pressure of 50 pounds above the atmosphere per square inch,* the total evaporation will be nearly 1800 pounds, or 28·8 cubic feet of water, producing, according to Pambour, 8611 cubic feet of steam per hour.

The condenser is composed of a number of small vertical pipes, of thin material, exposed to the current of air produced by the flight of the carriage. In our publication of the 11th ult., No. 1022, Mr. Craddock showed the efficacy of this plan of condensation. Mr. Henson reckons on obtaining an available vacuum of from 5lbs. to 8lbs. per square inch: he proposes also to use the steam expansively, cutting it off at one-fourth of the stroke.

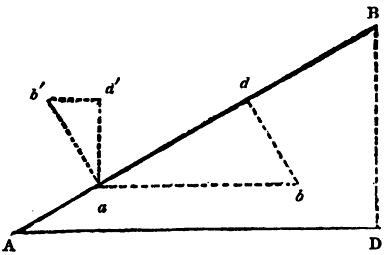
From these data, if realized, it follows that his steam-engine will be of about 17 horses power, even according to Tredgold's formula, in which the deduction for friction is specially inapplicable to the present case. Mr. H. proposes a degree of expansion, which, as he is necessarily without an effective fly-wheel, we think is incompatible with the steadiness of action his carriage will require; and, but that we think he must be content with less gain of this kind than he contemplates, we should have been ready to give his engine credit for a power of 20 horses. To augment its power, however, to a great degree, without materially adding to its weight, there are in reserve the conduction pins of Mr. C. W. Williams, and other inventions which have been recently matured. The quantity of water required to work this engine is but 20 gallons: the weight of the entire engine and water is only about 600lbs.; that of the entire machine, engine, water, fuel, managers, passengers and cargo, ready for flight, is estimated to be about 3,000lbs.

The entire weight divided by the entire area gives a load of two-thirds of a pound to the square foot. Many birds are loaded to the amount of an entire pound to the same area. The advantage in favour of the machine is somewhat increased by the known fact, that the resistances of large surfaces are somewhat greater on an equal area, than those of small ones.

That branch of mechanical philosophy which should supply the facts and arguments required by the remaining investigation is confessedly obscure and unsatisfactory; the very points which are of vital consequence to this invention are those on which theory goes singularly astray, and experiment is as singularly deficient. We shall, however, apply to this important case, the common theory as it stands, partly that attention may be drawn to its great defects.

In the diagram (next page) let A B represent in section the main plane or wings of the machine; A D is an horizontal line; the machine is supposed to travel from A towards D, and its lower edge A to be always in the line A D. The air is supposed to be perfectly still. The machine is supported by the resistance created by the impulse of its under surface on the air as it advances: but the same resistance which hinders its fall hinders its advance, and if unopposed gradually destroys its sustaining velocity. To learn, therefore, what power is required to keep up the original velocity of flight, we have to ascertain, first, what speed and inclination are requisite to obtain from the air the necessary sup-

* See Parkes on Steam-boilers, Table, page 47, col. 41.



port; and, secondly, what is the retarding effect produced by that speed and inclination?

If the surface A B had been perpendicular to its own path, there would have been comparatively little difficulty in ascertaining very nearly the pressure occasioned by its impact on the air; the ordinary theory (which proceeds on the supposition that each particle of air is struck once, and then retires between its fellows without further effect) concludes that the pressure on a given area, at a given velocity, is equal to the weight of a column of air standing on the given area, and so high, that a body falling from its surface would acquire the given velocity. A column of air, whose horizontal section is a square foot, and which weighs one pound, is 13·28 feet high; a body falling that height acquires a velocity of 29·15 feet per second; from which it is inferred that a plane surface of a foot square, moving in air at that velocity, and perpendicularly to its own path, encounters a resistance of just one pound. Different weights of resistance attend velocities which are as the square roots of the weights. To state the same assertions algebraically, let f be the resistance in pounds, and v the velocity in feet per second; then,

$$\sqrt{f} = \frac{v}{29{\cdot}15} \quad \text{or } f = \frac{v^2}{849{\cdot}7}.$$

But experiment has shown (Young's Nat. Phil. vol. 2, p. 229) that the resistance is somewhat greater than this, and is better represented by

$$\sqrt{f} = \frac{v}{22{\cdot}36} \quad \text{or } f = \frac{v^2}{500}.$$

We shall suppose this formula to be near enough to the truth for the present purpose, although some experiments would indicate a still higher ratio of resistance to velocity.

It is next necessary to deduce from this result, if we can, the resistance of surfaces which are oblique to the line of their own path. This has been attempted by considering, first, that the oblique surface now encounters a stream of wind, not of its own entire depth as before, but only of the depth B D, or of the sine of the angle B A D; and, again, that the force of the air, or the impact of the surface, is exerted in the direction $b\ a$, while the resistance of the plane is in that which is perpendicular to its own surface, or $b\ d$; the necessary resolution of the force gives again, for the measure of its efficacy in the last-mentioned direction, the same quantity, viz., the sine of $b\ a\ d$, or of B A D. It is concluded, therefore, that the pressure sustained by the oblique plane, in the direction perpendicular to its own surface, is as the square of the sine of its inclination. Or if we make $a\ b$ equal to B D, and draw $d\ b$ perpendicular to A B, we shall have the following proportion:—A B : resistance to perpendicular surface : : $d\ b$: resistance to oblique surface in the direction $d\ b$, perpendicular to itself. But this resistance must be again resolved into two, of which the vertical component will give the support given to the machine, and must be equal to its weight; and the horizontal one the horizontal resistance to flight. This is conveniently done by making $a\ b' = d\ b$, and drawing $d'\ a$ and $b'\ d'$; the former will give the resistance to falling, and the latter the resistance to flight; that is, since $\angle\, b'\ a\ d' = \angle$ B A D, denoted by r, the resistance to falling is represented by $\sin.^2 r \cos. r$, and the resistance to flight by $\sin.^3 r$; these quantities being each multiplied by the resistance to a plane of the same area, when perpendicular to its own path. (Greg. Mech. vol. i., page 545; Marrat's Mech. page 258, &c. &c.)

If this theory were to be relied on, we should then have $f = \frac{v^2}{500} \sin.\ ^2 r \cos.\ r$ for the resistance to falling, on each square foot, from which it is easy to learn the velocity which would sustain the machine at a given angle, or the angle required at a given velocity. As we have to do chiefly with small angles, and have no exact purpose in view, we make $\cos. r = 1$, and then $500\, f = v^2 \sin.\ ^2 r$, or $22{\cdot}36 \sqrt{f} = v \sin.\ r$.* If the load be, as in

* From this equation it follows, that, as long as the angles are so small that cos. r may be taken =

Mr. H.'s proposed machine, ⅔ lb. per foot, and the speed 50 miles an hour, or 73·3 feet per second, we get

$$\frac{22{\cdot}36 \times \sqrt{\tfrac{2}{3}}}{73{\cdot}3} = {\cdot}249 = \text{sin. } 14^\circ\, 25'; \text{ that}$$

is, the angle so discovered would be necessary, in the case supposed, for sustaining the weight of the machine. But since the vertical and horizontal resistances are to each other as the cosine and sine of the same angle, and the vertical resistance is here equal to the weight of the machine, or 3000lbs. we shall find that the resistance to flight

$$\text{is } \frac{\sin 14^\circ{\cdot}\,25}{\cos 14^\circ{\cdot}\,25} \times 3000\text{lbs.} = 771\text{lbs.}$$

to remove which, at the rate of 50 miles per hour, would require a power of about 100 horses.

We have thus far pursued the enquiry in this manner with the view, not of establishing thereby a true result, (for the existing scientific apparatus is not sufficient for that purpose) but of clearing the way for a statement of what is needed to that end. The theory is utterly at variance with natural facts. According to it, a bird weighing 10lbs., and loaded to the amount of one pound per square foot, must exert in its flight, merely to keep up its sustaining velocity, a force nearly equal to six-tenths of a horse power; and at 20 miles an hour, its front must present an inclination equal in average effect to that of a plane elevated nearly 50 degrees. It is clear that the position thus assigned by the theory is very far from that which birds assume, and if their muscular power has always been supposed to be very large, nobody ever imagined that two geese would overpower one horse.

The experiments of Robins, Borda, Hutton, &c., clearly show that the true state of the case, while it has some faint and general resemblance to the results of the theory, is brought about by circumstances which that theory does not take into account; in fact, here as elsewhere theory fails, not because its argumentation is incorrect, but because the assumptions on which it is founded are incomplete. And here recorded experiment also fails to furnish the facts necessary for our guidance. We cannot discuss the subject in this article with the particularity its importance demands, but it is essential to remark the two principal points in which the experiments are defective. First, while they include angles from all parts of the quadrant, they pay but slight attention to the small ones concerned in this question: now it is precisely at these small angles that the results of theory and experiment most widely differ, and no theorem deduced from the resistances at greater angles, reproduces with even tolerable correctness those which affect the present enquiry. The experiments themselves are so few, and so little varied, that nothing can be concluded from them. (See Hutton's Dict., art. RESISTANCE; Young's Nat. Phil., vol. ii., page 230; Greg. Mech. vol. i., page 563.)

Secondly, the experiments were almost, if not quite exclusively, made with the view of ascertaining the resistance in the direction of flight, and they tell nothing of the *downward* resistance. Now, here it is indispensable to know both. Until we know the angle and velocity which will give us a downward resistance equal to the weight of the machine, we have no possible means of computing the resistance to flight; and if the theory is so disturbed by uncontemplated facts, that we cannot rely on it for one, it is clearly of no avail for the other. It seems from experiment that at these small angles the resistance to flight is very much greater than theory gives: but we are not informed whether the other resistance be greater or less, or, if either, how much. And this is a question of vital importance: for if the downward resistance be greater than by the theory, a smaller angle B A D will suffice for support, and by diminishing that angle we greatly diminish the resistance to flight. That there is some such reason for a diminished angle we think is manifest from the living instance we have adduced.

We might go on to point out discrepancies amongst the experiments, which seem to show that effects derived both from the nature of the aerial fluid, and

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1, the power required for maintaining the flight is equal at all speeds: with a high speed the angle will be small—with a low one, large. The additional power required to attain the high speed is applied at starting.

Keeping in mind the same limited application of the simplified formula, the number of horses' power required to maintain the flight may be exhibited thus: let w = the entire weight, and a the entire area; then,

$$n\ \text{H. P.} = \frac{22{\cdot}36}{v} \cdot \frac{\sqrt{w}}{\sqrt{a}} \cdot \frac{60\,v\,w}{33000} = {\cdot}0406\,\frac{w^{\frac{3}{2}}}{a^{\frac{1}{2}}}.$$

the frictional condition of the surfaces experimented on, have not only interfered with their results, but will greatly influence Mr. Henson's success. We have said enough, however, for our present purpose, which is to prevent that misapprehension of the probabilities in this most important case, which might arise from undue reliance on our present knowledge, and to exhibit what appears to us to be the points which remain to be elucidated. In the absence of more certain knowledge, we have only probabilities for our guidance; but, as far as we can collect and judge of them, they are in favour of Mr. Henson's success, so far as the power of floating through the air is concerned; and we think he has done wisely in following the indications of nature, undeterred by the results of a theory which is confessedly incomplete.

One point to which considerable uncertainty obviously attaches is that of the ability of the steam-engine to overcome the resistance to flight; but, on the other hand, there is first the probability that the force required is comparatively small, and, secondly, the known practicability of increasing the power of the engine to more than double its present amount.

Another more serious drawback is, that each aerial journey must consist of a series of flights from one prepared station to another; stations, too, which, if the scheme is to have the fairest possible play (as it ought to have) must be of considerable elevation. A line of such stations, however, in any given direction, will not cost so much as a railway does, and it is with railways that the aerial system—if ever brought into practical operation—will have chiefly to contend.

Want of time and space compels us to leave some other important mechanical points untouched. But for the present, we trust, we have said sufficient to give our readers a general idea of the principles concerned in the action of the machine—of the chief difficulties which stand in the way of its success—and of the extent to which we may rationally hope to see them overcome.

L: L.

[For the preceding paper we are indebted to a scientific friend, of whose ability to do justice to the subject, it contains abundant evidence. But while we agree with him generally in his views, and admit most freely that Mr. Henson's is a step in the right direction, we cannot, with our recollections of what has been done by preceding experimenters in the same line, see where the originality lies for which our friend seems so willing to give Mr. Henson credit. The truth is, that we can discover nothing of importance in the present scheme which has not been proposed, and even tried, before; with the exception, perhaps, of the steam-boiler; and even that seems to be rather a combination of various known contrivances (as Viney's cones, Williams's conducting-pins, &c.) than an embodiment of any original conceptions of Mr. Henson's own. Following this is a letter which we have received from Sir George Cayley, written *before* the enrolment of Mr. Henson's specification, and *before* the appearance of any account whatever of his invention, which will probably be considered as decisive on the point of originality. No man living has bestowed more attention on the subject of aerostation than the philosophical baronet—pursued it through so long a course of years, and with so much zeal and perseverance; nor is there any one who has brought to the consideration of it more science, or greater sagacity. Perhaps the greatest praise that could be bestowed on the present scheme of Mr. Henson is, that it happens to coincide so closely with the previous experiments and conclusions of so great an authority in such matters.—Ed. M. M.]

RETROSPECT OF THE PROGRESS OF AERIAL NAVIGATION, AND DEMONSTRATION OF THE PRINCIPLES BY WHICH IT MUST BE GOVERNED. BY SIR GEORGE CAYLEY, BART.

Sir,—Within the last six months there has been considerable excitement evinced respecting a scheme for transporting men and goods through the air by mechanical means, without the aid of balloons to sustain the weight intended to be thus conveyed. The proposal was announced in so decided a manner, and in such startling terms, that in these days of mechanical wonders some were disposed to give full credence to the practicability of the undertaking, and others to reject it as a visionary hoax on public credulity.

About thirty years ago the subject of aerial navigation by mechanical means was much canvassed, and several papers were published on it in Nicholson's Chemical Journal, the Philosophical Magazine, &c. Many experiments as to the means of support, and the stability and guidance of such machines, were then made on a large scale, some of the experimental vehicles having three to four hundred feet of canvass extended on masts, and braced by rigging, to give strength and precision of position to their surfaces. These trials proved in the most decided manner that perfect stability and guidance were effected, and that the means of support, to a certain limited extent, were attainable. For instance, it was proved that a man placing himself in a machine of proper dimensions for his weight at the top of a mountain, say one mile above the level of the plain below, might in calm weather with steadiness and security proceed through the air to any place to which he might choose to steer himself, about eight miles in horizontal measure from

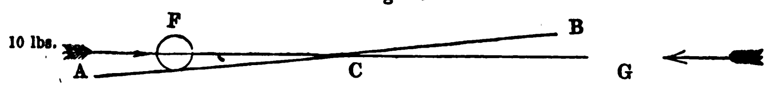
the point of his departure. Of course, in this case the line of flight must be in a continued descent of one in eight, and gravitation is the only cause of the progress of the machine; the case being in some measure similar to that of a carriage running down hill without horses. If instead of this machine being allowed to descend in its path by gravity alone, the man had applied his power to propel it, by revolving oblique fliers, or other suitable means of waftage, he might probably have extended the distance from eight to twelve or fifteen miles; but the muscular strength of a man is not sufficient to maintain a horizontal path, unless it be for a very short time.*

To render aerial navigation by mechanical means alone, efficient, some first mover is required, which combines great force with little weight. The steam-engine, in any of those permanent forms, calculated for real service, together with the water and fuel it requires, would probably be found very inconveniently heavy for the purpose, if not absolutely inefficient,† and I believe it was this consideration, coupled with the serious expense of ascertaining the fact practically, which, at the date I have alluded to, operated as a check to future enquiry on the subject. When, however, a lighter first mover should be invented, every other part of the apparatus was in readiness to meet the discovery, and realize the scheme.

As the principles of aerial navigation by mechanical means are few and simple, a recapitulation of them at the present moment may not be unacceptable to your readers, and may enable them to judge more correctly of the project I have alluded to, when more distinctly presented to the public.

The leading principle of aerial navigation is that of the inclined plane. Suppose A B, fig. 1, to represent an inclined plane, rising one foot in ten; it is well known that if the

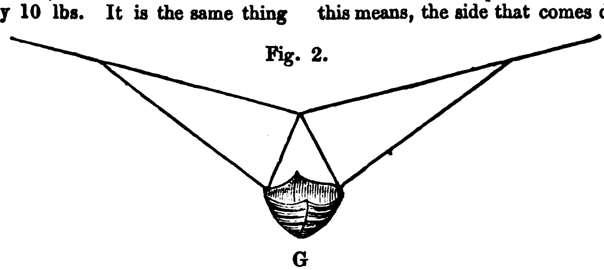
Fig. 1.



ball F, weighed 100 lbs., a force of 10 lbs., applied horizontally, would sustain it from rolling back. Conceive the same line A B, to represent, also, the section of a large surface, like the sail of a ship, and that C G represents a cord by which it is sustained from being driven back by a horizontal wind, blowing in the adverse direction. If the sail contains 100 square feet of surface, and the wind has sufficient power to press with one pound to the foot, 100 pounds weight will be supported, and the tension on the cord will be only 10 lbs. It is the same thing whether the wind thus blows against the sail, or the sail be driven, with equal velocity, horizontally in calm air; the 10 lbs. propelling power, will still sustain the 100 lbs. in the air. It is difficult to ascertain the precise angle used in the wings of birds; but one in ten certainly exceeds that of most birds, and probably one in sixteen is nearer the truth.

The stability of these machines is maintained laterally, by making the surface in its cross section as represented in fig. 2. By this means, the side that comes down in any

Fig. 2.



heel of the vehicle, meets a *greater* resistance, whereas that which has necessarily gone up, meets with *less*, and this contrary action, operating on a large extent of leverage from the centre, immediately restores the proper position. The distance of the centre of gravity G, below the centre of support, also tends greatly to increase this power, and

* Many years ago, Mr. Degen who was a prisoner at Vienna, by means of large surfaces formed like umbrellas, succeeded in elevating himself fifty feet, as measured by a cord which was attached to his machine by the gaoler for safe custody, but at the expense of the total exhaustion of his muscular strength in a couple of minutes. A man when running up stairs for a few seconds is exerting the ordinary power of two horses—being twelve times greater than the power he can use with permanent effect.

† The water used in the high pressure tubular boilers amounts to about 70 pound per horse power per hour, the fuel about 10, so that the food of the steam horse is about 80 per hour. The engine itself, if of the lightest efficient structure, may weigh about 150lbs. to the horse power. If the steam were condensed again, by exposure within extended surfaces to the cooling influences of the current of air no larger supply of water would be required, but such extended surfaces are inconvenient, and add greatly to the weight.

mainly contributes to the stability of the machine in the line of its path. This, however, is also aided by the adaptation of a horizontal rudder, like the fan tail of birds, used for the purpose.

The side guidance is perfectly effected by a rudder in a vertical plane, as in the case of ships, and elevation and descent are produced, in ordinary cases, by having the command of the horizontal rudder already noticed; but when progressive motion is not required, and the ascent or descent is to be made perpendicularly, then the effect is produced by the power being applied to extensive oblique vanes or fliers, which, when not employed in this way, are so made as to become flat, and thus form the surfaces already described. The progressive impulse is most readily obtained by smaller oblique vanes, like the screw propellers in boats, worked by the power of whatever engine is employed; or the oblique wing waftage, as is used by birds, may be employed.

The real question rests now, as it did before, on the possibility of providing a sufficient power with the requisite lightness. I have tried many different engines as first movers, expressly for this purpose. Gunpowder is too dangerous, but would, at considerable expense, effect the purpose; but who would take the double risk of breaking their necks or being blown to atoms? Sir Humphrey Davy's plan of using solid carbonic acid, when again expanded by heat, proved a failure in the hands of our most ingenious engineer, Sir M. Isambard Brunel.

As all these processes require nearly the same quantity of caloric to generate the same degree of power, I have for some time turned my own attention to the use, as a power, of common atmospheric air expanded by heat, and with considerable success. A five-horse engine of this sort was shown at work to Mr. Babbage, Mr. Rennie, and many other persons capable of testing its efficiency, about three years ago. The engine was only an experimental one, and had some defects, but each horse power was steadily obtained by the combustion of about 6½ pounds of coke per hour, and this was the whole consumption of the engine, no water being required. Another engine of this kind, calculated to avoid the defects of the former one, is now constructing, and may possibly come in aid of balloon navigation—for which it was chiefly designed—or of the present project, if no better means be at hand.

I remain, Sir,

Your obedient servant,

GEO. CAYLEY.

London, March 25.

PILBROW'S DISCOVERY IN STEAM POWER.

Sir,—It is probable that, since the first publication of your useful work, nothing which has ever appeared in it has caused so much astonishment as the announcement of a "new discovery of the properties of steam." There is originality in the very boldness of the assertion. To declare that new properties have been found out in a power known to us for 2000 years, and considered to be exhausted by every investigator and writer on the subject, is of itself a marvel. And he must, indeed, be a bold man who, with one vigorous bound, throws behind him all the glorious inventions and adaptations of his great predecessors, and declares, without experience to guide him in the application of his invention, that "the present steam-engine is a grand practical blunder!" Unless he adduces better evidence than mere assertion to support his dictum, we can only look upon him as one of those interesting monomaniacs whose originality of thought has lately been so conspicuous, and recommend his friends to keep a strict watch upon the eccentric wanderings of his imagination. As Napoleon conjured up the departed spirits of forty ages, to behold his heroic deeds from the summit of the most ancient monuments of the world, so the shades of De Caus, Worcester, Papin, Savary, Newcomen, Beighton, Smeaton, and Watt, seem to rise before me to forbid the labours of 2,000 years to be overturned. I think, indeed, I see the shade of that venerable man, on whose face sat "the personification of abstract thought," listening with a mournful surprise, between incredulity and conviction, to the exposition of these new properties in steam; and admitting, with a sigh, that there is, indeed, more in it than is at first dreamt of in our philosophy. That great mind would, I am sure, have been the first to seize, with lightning-like penetration, the application of the simple, but precise and unalterable, laws of force and motion to steam, and admit the vast train of important consequences which must, I think, inevitably follow. Sure it is, that a new field for scientific research has been opened by Mr. Pilbrow. And yet, can a sound mind allow itself, even for a moment, to suppose that the five statues erected to the most illustrious name in the whole

range of the useful arts will, by and by, chiefly commemorate the author of an engine "in harmony with no motion in the universe, standing alone, a singular departure from the laws of nature;" that the genius of Chantrey and the inscription of Brougham do but unite in that glorious statue in Westminster-hall to point out to succeeding generations the inventor of "a grand practical blunder;" and that the oration of an Arago, and the unanimous homage of the greatest intellects which have adorned this or any country, combine only to render "the great mistake" more conspicuous? So many considerations crowd upon the enquirer, so many contending suggestions of probability and reason, that it demands, in truth, all the composure of a calm and exact mind, not to smile at once at the absurdity, and to join in your concluding observation:—"Does it not, indeed, render it superflous to say a word more on the subject?"

But, happily, science is no respecter of persons. The sublime, but ever simple principles of nature exist immutable, independent of time and change, and are not unfrequently revealed to the lowly, after they have escaped, for centuries, the genius of the most penetrating. Permit me, then, to make a few observations on the principle of the extraordinary disclosure in your last Magazine, passing over Mr. Pilbrow's engine, since your description of it is insufficient to enable any opinion to be formed of its efficiency. Even if his discovery be wholly erroneous, and you should be correct in expressing your "firm conviction that there is nothing in it," still it is too original to be passed by unnoticed. An original error, indeed, if fairly and properly pursued, may be of more service to science, by leading to the most important results, than the improvement of a well-known system. "The most important of my discoveries," exclaimed Sir Humphrey Davy, "have been suggested to me by failures." There is, too, a peculiar charm to all minds in originality. To leave the beaten paths of the known for the fresh but intricate wilds of the unknown, and, in these days of common-place, to wander where no other footsteps have ever trod—to scale the hidden heights of nature or of science, and to feel that you are there alone, of the millions of the earth—produce a grandeur and sublimity, and elevation of thought, which most persons can enter into, even if leader and follower meet at last only with disappointment.

The great principle of Mr. Pilbrow's discovery in the properties of steam seems to be, that "it possesses, in its mere velocity alone, a propulsive force from its *lineal expansibility*, equal in power and duty to the gross effect obtained when cut off, and allowed to expand under the best circumstances." In verification of this new-found power, some singular and interesting experiments are given at p. 241, to show how that force, which steam possesses from its expansive velocity, must be obtained. If these experiments were correctly made, and the table at page 242 be correct, it is impossible not to consider Mr. Pilbrow's discovery one of the grandest and most original of the age; and, next to the expansibility of steam, the most important in this science. The experiment, indeed, with the flat plate, and then with the cavity, seem to me two of the most beautiful, and conclusive, and important experiments with which I am acquainted. No laws are more precise, or better understood, from their simplicity, than the laws of force and motion; and their application to the new phenomena recorded at page 241 is only consistent with our previous knowledge of the subject. That a current of steam or water—for the *fact* must be so with other fluids—directed against a flat plate would give out only half of the force it would deliver into a cavity is obvious. Theory would predict it prior to experiment, because, as action and reaction are equal and contrary, it must require a force (or resistance) to reverse entirely the motion of a fluid equal to the force which put that fluid in motion. But, as steam and water would glance off a vane or flat plate, and continue their motion, the resistance is not sufficient to reverse the action, and thus obtain the force of reversal; consequently half the force only is received on the plate, the other half being expended in a direction which is unavailing. It is, therefore, sound philosophy to arrest the whole velocity of the steam by "injet" into a cavity; and, by sending it back in the line of its advance, get that "double effect," or force, the half of which is uselessly expended by the current glancing off a flat plate. And though the word "injet" is not English, yet, it being

the privilege of science to add new names to our language, expressive of new results, it is, I think, properly coined to distinguish the peculiar action of Mr. Pilbrow's jet of steam, and its effect, from mere impact or impingement. A jet of steam impinging against a vane, as in Branca's engine, will give only the force of impact, because only half of the velocity is arrested; but it must, I think, be evident that, by arresting the other half by a jet of steam, rushing "in" to a cavity, and thus reversing the *whole* motion, you also obtain the additional force of reversal, and so "double the effect." To obtain this double power, then, is simply to make the most of the power available, and secure an effect only equal to the cause; for on a flat plate the power or effect is *not* equal to the cause.

When a new discovery is made, it is very remarkable how immediately it is found to range itself under some well-known law, and how beautifully it is in harmony with a vast class of well-known facts; but which, previous to the new experiment, were never considered applicable to the discovery. The mind, too, instantly seizes hold of these new facts to generalize them, and almost intuitively discovers analogies by which they may be confirmed. That steam possessed a power from its mere velocity alone, was ascertained by Hero, 120 years B. C.; and many revivals of his engine, by Craig, Ruthven, Avery, and others, have made this fact familiar to the public. But it was never known, until Mr. Pilbrow's discovery that, by a peculiar application of the velocity of steam, it possessed a propulsive force equal to what is obtained by the present system. This seems to be the grand discovery hitherto unknown to science. Yet those very difficult subjects, sound and light, show, by the most familiar instances, how "double the effect," may be obtained by a particular mechanical arrangement. Mr. Pilbrow's object is to concentrate the force. So, by concentrating the rays of light by reflectors, simply by surrounding the burner by a tin cone, the rays are prevented from being expended in a line in which they would be useless, and are thus thrown back upon the object, and "double the effect" produced. Sound, too, is thrown back, that is, its velocity is arrested by any concave substance, and an echo, or "double effect," produced. In both cases, "double the effect" is obtained from the same cause, and simply by a mechanical arrangement, just as steam, rushing by its mere velocity into a cavity, produces "double the effect" of its impingement on a flat plate. As regards sound, indeed, I remember an instance singularly in point, which I read many years ago, I believe in Dr. Arnott. A ship was sailing a hundred miles from land, yet the bells from the island church were distinctly heard by the passengers on board. The effect, at that distance, in a calm and beautiful evening—communicating tidings of a life on shore to the minds of the voyagers, alone on the waste of waters, out of sight of land—must have been singularly beautiful and affecting. Yet the fact is accounted for on the same principles. Sound, like light, being communicated by the undulatory motion of an elastic fluid, was conveyed without check in the line of its impulse, and, like a spirit wandering to find some ear into which to whisper its tidings, was "arrested" by the sail of the ship, and poured forth its music into the hearts of the astonished and awe-struck passengers. Its velocity was "caught up before it became exhausted;" and thus, what seems ridiculous in steam is proved to be a true principle by an independent illustration. Such are the general laws of nature, and such are the simple and beautiful analogies which, on every new discovery, are found to exist throughout every motion of the universe.

Other illustrations of "double the effect" being obtained by a particular form of resistance, and of only half the resistance or effect being received by a particular shape, must occur to every reader. When a ship is going before the wind, the more concave the sail the more velocity it takes out of the wind, and the stronger its impulse; though, like horizontal windmills, by this very effect, the sail deadens and intercepts the wind from the others, and thus, a less surface being exposed in one sail than in many, neither ships nor windmills are worked in this way. The bows of ships, the shape of birds and fishes, the angular shape of bastions and fortifications, offer less resistance by their wedge-like form, than if concave. I have seen, too, many a cuirass, whose angular shape has turned aside the death-dealing velocity of the

musket ball, and many a one where the bullet, striking from the side, has met with a greater resistance, and carried death to the wearer. If two balls of the same weight be fired with an equal charge of powder against a cuirass, one against the front, the other against the side, the one will harmlessly glance off, whilst the other will penetrate, and give "double the effect." In the one case, the resistance being insufficient to arrest the whole velocity of the ball, the power of motion was uselessly expended; in the other, all "the impulsive momentum" was stopped, and it did its work. This, I think, is an instance in verification of the principle that "double the effect" may be obtained from the same cause, by a particular adaptation of resistance, even from an inelastic, unexpansive body.

The extraordinary effect of the pressure, given at page 242, can, I think, only be accounted for by the expansive velocity of the steam. "The contraction of the outlet orifice" is assuredly not "the obvious cause of the phenomena." No force is described to be exerted to concentrate the steam on one part more than on another, and which is impossible to be done. The steam itself is manifestly unequal to the effort; otherwise, a pipe of an inch area, leading from a pipe of 4 or 6 inches area, would indicate a pressure of double the amount, which we know is not the fact, by the pressure in the small steam-pipe leading to the gauge. Besides, nothing is better understood than the science of hydrodynamics, or at least of its fundamental law, which applies equally to elastic fluids or to liquids, namely, pressure in all directions, by which all fluids have a tendency to an equilibrium in an instant of time. Now, depending upon this immutable law, I will venture to assert positively that the contraction could not have been the cause, and consequently that, if the experiment suggested at page 244 be made by halving the area of the outlet, instead of "double the effect" of a ⅝ths orifice being obtained (4 lb. 6 oz.), only half of 2 lb. 3 oz. (or 1 lb. 1½ oz.) will be obtained. The reason is, that though the velocity will be the same at 10 lb. pressure, the mass will only be half the weight; consequently, the effect or power will always be in proportion to weight and velocity. I need not say that this experiment has never been tried to my knowledge, nor has the following, which will, I think, set the fact of Mr. Pilbrow's discovery for ever at rest, and very conclusively. We see that steam not only has the power to raise the safety-valve when above the pressure at which it is weighted, but that it keeps it there by impingement or percussion. To prove, then, whether "double the effect" can be obtained from the same cause or pressure, so adjust the valve that it can be surrounded with a cone, into which the steam may rush, and its velocity be reversed. Or, more conveniently perhaps, fix an upright pipe on the top of the steam-chest, having an opening whose area shall be 1 square inch. Cover this pipe with a cone or extinguisher, closely fitting, to prevent steam escaping, and let it be fixed to the pipe in any way that will enable the cone to play freely up and down. Say that the pressure is 20 lbs. in the boiler; the cone must be weighted to double that pressure (40 lbs.). Now for the grand trial. Lift the lever or cone (if the 40 lbs. be placed on a flat made on the top for that purpose), simply to allow the steam to rush into the cone, and I feel a confident conviction, which I do not hesitate to place on record, that when let go, the steam, at only 20 lbs. in the boiler, will keep raised this valve with 40 lbs. on the top of it, producing "double the effect," from the same cause which, with a flat valve, gave out only half of the power.

I would merely observe, in conclusion, that if I may be considered premature in placing on record my opinion of the soundness of Mr. Pilbrow's discovery, I am well content to set the risk of being in error against the merit of being the first to recognize the philosophy of the application of the laws of force and motion to steam, and to hail with enthusiasm a simple and beautiful discovery, which, in my opinion, will immortalize its author, and form a new era in the steam-engine and the useful arts.

SCALPEL.

March 28, 1843.

P.S. The desire I feel to be in time for your next Magazine prevents my paying that attention to perspicuity which I would wish to observe. But the subject is a wide one, with ample room for further explanation.

Note.

Mr. Pilbrow is fortunate in having met with so powerful a champion as our esteemed correspondent "Scalpel," and would have been more so, but that "Scalpel" has brought to his aid his best trumpet only, and left all his famous heavy artillery behind. The question on which we are at issue with Mr. Pilbrow is, one of dry fact; for which therefore flourishes of any sort can do but little. Mr. Pilbrow asserts that there is a power "in mere velocity alone," exclusive of and supplementary to the boiler power by which it is produced, and this which he calls a "discovery," we have pronounced to be a "grievous mistake." Who is right? Is there any such power in "mere velocity alone," or is there not? This is the whole question. Now how does "Scalpel" address himself to it? Simply, by evading it altogether. He does not offer a single word in support of Mr. Pilbrow's notion of the way in which his double power is obtained (by the exclusion of lateral pressure); and he leaves entirely untouched the several reasons we have given, for believing such duplication of power to be a physical impossibility. He cites, indeed, numerous instances to show how double effects may be obtained by the use of concave surfaces; but this, though it may be a theory of "Scalpel's" is not Mr. Pilbrow's. All that Mr. Pilbrow claims on behalf of the concave surfaces is, that they enable him to catch up and turn to working account the double power which, according to his theory, is derived from "*the mere velocity alone.*" With him they are the means merely of carrying his "discovery" into effect; with his advocate "Scalpel," they form the discovery itself. Let us recur to Mr. Pilbrow's own words:—"By this peculiar direction of the injet system, and its clear reaction or reissue, about *double the effect* is obtained by its mere impact or impingement against a vane or flat surface. FOR, ALL THE VELOCITY OF MOTION OR IMPULSIVE MOMENTUM OF THE STEAM IS THUS ARRESTED," &c. The reason (the "For") assigned, is not that there is any duplicating virtue in the cavities, but that they "arrest" the "impulsive momentum," or double power acquired by the current of steam. The language which "Scalpel" himself uses, in speaking of the double effects to be obtained from concave surfaces, shows clearly that according to *his* view of matters, velocity has nothing to do with the production of these effects. With him it is "concentration" which accomplishes every thing. And so we say, it was concentration alone which produced those results, which have deceived Mr. Pilbrow into the belief of the double power to be obtained from velocity; but though we might naturally have expected "Scalpel" to go along with us in this conclusion, the reader must have been startled to observe how inconsistently he turns round upon us towards the conclusion of his letter, to assert that in Mr. Pilbrow's case, so far as the nozzles are concerned, concentration had no influence whatever! The reply to this is short. If the extra pressure indicated at the point of the nozzle was not produced by the contraction of the area of escape, (and consequent *concentration* of the current of steam,) why was it contracted at all? Why not leave the discharge pipe as it was, with the same area throughout? If it be a fact that there is a power in velocity, not arising either from the pressure in the boiler, or the contraction of the discharge pipe, Mr. Pilbrow ought to be able to establish that fact, without having recourse to contracted orifices or concave surfaces, or any other adventitious aid whatever. Let him use a discharge pipe of the same area throughout, and tell us what the difference is which he finds between the pressure at the boiler end, and the pressure at the end open to the atmosphere. If he find, under such circumstances, the pressure greatest at the greatest distance from the boiler, we shall then admit—*but not till then*—that he has indeed made a very great "discovery."

"Scalpel" complains of our description of the machinery by which Mr. Pilbrow proposes to carry his "discovery" into effect, as being "insufficient to enable any

opinion to be formed of its efficiency." We must say, that we do not consider this to be a very fair observation on the part of our friend "Scalpel." If the principle of the entire machinery be fallacious—if there be really no "discovery," but a "grievous mistake," in the case—what need can there be to trouble ourselves about details? Besides, be this as it may, the description which we gave was, in all but the omission of references to drawings, Mr. Pilbrow's own description, and given in his own words.

If any thing were wanting to confirm us in the opinion we have expressed—not without reluctance—of Mr. Pilbrow's invention, it would be found in the fact, that a writer of "Scalpel's" acknowledged ability, and great familiarity with the subject of steam, (as evidenced by many former communications from his pen,) has failed so entirely to shake the grounds on which that opinion was founded. We repeat once more our firm conviction that "there is nothing in it."—Ed. M. M.

DEATH OF SIR JOHN ROBISON.

The mechanical arts have sustained this month a severe loss in the death of this eminent and much esteemed individual. If not the best, he was certainly the most useful amateur mechanic of his time—an active and liberal friend of every institution or undertaking calculated to promote the improvement of our arts and manufactures—and himself the author of not a few inventions of great ingenuity and merit. From the first establishment of the *Mechanics' Magazine* he was one of its warmest supporters, and continued to the last to enrich pages with his contributions. His latest communication was a paper on Wire Gauges with the signature "K. H.," inserted in the *Magazine* of the 3rd of Dec. last. The death of Sir John took place at Edinburgh on the 7th instant. For the following brief memoir of him we are indebted to the *Athenæum.*

"Sir John had been seriously indisposed for more than a week, and the causes of death were water on the chest and disease of the heart. To his intimate friends it had been well known, that his health was by no means in a satisfactory state, and for the last six months he had been subject to slight attacks of a threatening character. Those who were acquainted with the energy and activity of Sir John, and his strong and healthful appearance, will be surprised to know that his age was sixty-five; but on the other hand, when it is known that he went out to India at the age of twenty-four, that he remained there until he had acquired a considerable fortune, and that he has now been twenty-eight years engaged in a very active life at home, they will be no less astonished that he could have done so much in so short a time. In India, his mechanical skill was the principal cause of his rapid success. Always devoted to mechanical pursuits, and of a very ingenious and inventive mind, he attracted the attention of the Prince of Nizam, whose artillery he was employed to remodel; and he soon raised it to the standard of European perfection. Success in this undertaking led to the favour of the court, and he was successively employed in the construction of important engineering works in that country, by which he continued to increase in favour and success, until, in 13 years, he was able to return home with a respectable fortune, the reward of his energy and mechanical skill.

"Next to his own family and personal friends, his loss will be most deeply felt in the Royal Society of Edinburgh, and in the Royal Scottish Society of Arts. Of the former he has for many years been the secretary, and the amount of time and zeal he devoted to its duties, his accurate business habits, and the zealous, affable and disinterested manner in which he discharged its duties, had a great deal to do with the measure of success which attended the meetings of that learned body. His hospitality to foreigners and distinguished scientific strangers was widely known and acknowledged, and the amenities of science were never better or more cheerfully administered. Of the Society of Arts he had been one of the founders, along with Sir David Brewster, and Mr. Tod; he was its President, and one of its very active contributors.

Sir John was a member of the British Association, one of its Council, and president of the Mechanical Section. He was associated with Mr. Scott Russell in the important researches carried on under the Association; and although his last act at the last meeting of that body was to disclaim his own right to share the merit of those researches, which he stated to have been planned and conducted by his coadjutor, yet the latter gentleman did not fail to acknowledge the valuable assistance he had derived from consulting with Sir John, and to ex-

press the great pleasure which he had enjoyed in his hearty and zealous co-operation in all that could promote the objects of their scientific inquiries.

"Next to the promotion of the interests of science, his favourite occupation was the pursuit of mechanical amusements. He was an expert turner, possessed a workshop, where he spent much of his time, and bestowed great attention in bringing to persection various apparatus for constructing screws, turning metals, soldering, filing, and the like; and in several departments was the author of improvements which have incorporated themselves permanently with the arts in this country. Whatever he did, he desired to do in the best possible manner. He built a house, in order that he might improve the system of domestic architecture; and when he had accumulated a sufficient stock of further improvements, he sold it, built another; and it is well known, that in all respects, as regarded arrangement, comfort, beauty, excellent warming, and unparalleled ventilation, no houses were equal to them. His last house was absolutely perfect, and was adopted as a model by Mr. Loudon, who, in one of his late works, had it drawn for him, engraved, and fully described.*

"Sir John had some peculiarities—and which of us is without them?—but thus much may be said of him, that he was never known to undertake any duty which he did not most zealously discharge; he never slept with an unanswered letter except once, and it made him so miserable, that he awoke at three o'clock in the morning, got up and wrote the answer to it. His delight was to seek out talent in others and bring it out into its appropriate sphere of usefulness. He had inherited many of the good qualities of his distinguished father, the late Professor Robison."

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 25TH OF FEBRUARY, AND THE 25TH OF MARCH, 1843.

John Haggerston Leathes, of Norwich, gentleman, and William Kirrage, of the same place, asphalte manufacturer, for certain improvements in coffins. February 25; six months.

John Heathcoat, and Ambrose Brewin, of Tiverton, lace manufacturers, for certain improvements in the manufacture of ornamented net or lace. February 28; six months.

Gottlieb Boccius, of New-road, Shepherd's Bush, for certain improved arrangements and apparatus for the production and distribution of light. February 28; six months.

George Bell, of Dublin, merchant, for certain improvements in machines for drying wheat, malt, corn, and seeds, and for bolting, dressing, and separating flour, meal, and other like substances' March 1; six months.

John Frearson, of Birmingham, machinist, for improvements in fastenings for wearing apparel. March 2; six months.

Thomas Simpson, of Birmingham, manufacturer, for a certain improvement in buckles. March 2; six months.

Masta Joscelin Cooke, of Gray's-inn-square, solicitor, for certain improvements in the manufacture of artificial fuel. March 2; six months.

John Keely, the younger, of Nottingham, dyer, and Alexander Alliott, of Lenton, bleacher, for certain improvements in machinery or apparatus, for drying or freeing from liquid or moisture, woollen, cotton, silk, and different fibrous materials, and other substances, and also for stretching certain fibrous materials. March 2; six months. (Being a communication.)

William Walker, of George-yard, Crown-street, Soho, coach-smith, for certain improvements in the manufacture of springs and axles for carriages. March 2; six months.

Charles White, of Noel-street, Islington, engineer, for certain improvements in machinery for raising and forcing fluids. March 2; six months.

Robert Stirling Newall, of Gateshead, Durham, wire-rope manufacturer, for improvements in the manufacture of wire-ropes, and in the apparatus and arrangements for the manufacture of the same. March 7; six months.

William Newton, of Chancery-lane, civil engineer, for certain improvements in machinery or apparatus for making pins. (Being a communication.) March 6; six months.

James Pilbrow, of Tottenham, engineer, for certain improvements in the application of steam, air, and other vapours and gaseous agents to the production of motive power, and in the machinery and apparatus by which the same are effected. March 7; six months.

William Betts, of Ashford, Kent, railway contractor, and William Taylor, of the same place, plumber, for improvements in the manufacture of bricks and tiles. March 8; six months.

William Kenworthy, of Blackburn, Lancaster, cotton spinner, for certain improvements in machinery, or apparatus called "beaming or warping machines," March 11; six months.

Charles Chilton, of Gloucester-street, Curtain-road, and Frederick Braithwaite, of the New-road, engineer, for improvements in machinery for cutting or splitting wood for fuel and other purposes. March 16; six months.

Arthur Chilver Tupper, of New Burlington-street, Middlesex, gentleman, for improvements in the means of applying carpets and other covering to stairs and steps, and in the construction of stairs and steps. March 16; six months.

Alexander Angus Croll, superintendent of the gas-works, Brick-lane, Middlesex, and William Richards, of the same works, mechanical inspector, for improvements in the manufacture of gas for the purposes of illumination, and in apparatus used when transmitting and measuring gas or other fluids. March 16; six months.

Angier March Perkins, of Great Coram-street, engineer, for improvements in the manufacture and melting of iron, which improvements are applicable for evaporating fluids, and disinfecting oils. March 16; six months.

John Thomas Betts, of Smithfield Bars, gentleman, for improvements in the manufacture of metal covers for bottles and certain other vessels, and in the manufacture of sheet metal for such purposes. (Being a communication.) March 16; six months.

Frederick Cook Matchett, of Birmingham, manufacturer, for certain improvements in the manufacture of hinges. March 16; six months.

Martyn John Roberts, of Brynycaeran, Carmarthen, gentleman, for improvements in the composition of ink, blacking, and black paint. March 16; six months.

* The description is contained in the First Supplement to Mr. Loudon's Encyclopædia of Cottage Farm and Villa Architecture and Furniture.

James Malam, of Huntingdon, gas engineer, for improvements in the manufacture of gas retorts, and in the modes of setting gas retorts. March 16; six months.

William Laycock, of Liverpool, merchant, for improvements in constructing houses and such like buildings. March 16; six months.

Wakefield Pim, of the Borough of Kingston-upon-Hull, engineer, for certain improvements in the construction or formation of buoys or other water marks. March 18; six months.

Alexander Simon Wolcott, of City-terrace, City-road, machinist, and John Johnson, of Manchester, in the county of Lancaster, machinist, for improvements in photography, and in the application of the same to the arts. March 18; six months.

William Barker, of Manchester, millwright, for certain improvements in the construction of metallic pistons. March 20; six months.

Solomon Rolinson, of Dudley, Worcester, roll-turner, for certain improvements in the manufacture of shot. March 20; six months.

Joseph Needham Taylor, of Chelsea, captain in Her Majesty's navy, and William Henry Smith, of 33, Fitzroy-square, civil engineer, for certain improvements in breakwaters, beacons, and sound-alarms; also in landing or transmitting persons and goods over or through strata or obstructions of any nature, all of which may be used either separately or in combination. March 21; six months.

Andrew Barclay, engineer and brass founder, Kilmarnock, Scotland, for certain improvements in lustres, chandeliers, pendants, and apparatus connected therewith to be used with gas, oil, and other substances, which invention is also applicable to other purposes. March 24; six months.

Gregory Seale Walters, of Coleman-street, merchant, for improvements in the manufacture of chlorine and chlorides, and in obtaining the oxides and peroxides of manganese in the residuary liquids of such manufacture. (Being a communication.) March 24; six months.

Alfred Hooper Nevill, of Chichester-place, Gray's-inn-road, corn dealer, for improvements in preparing lentils and other matters for food. March 24; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM JAN. 23 TO MARCH 22, 1843.

John Thomas Betts, of Smithfield Bars, London, gentleman, (being a communication from abroad,) for improvements in covering and stopping necks of bottles and other vessels. Sealed, January 23.

Thomas Thompson, of Coventry, Warwick, weaver and machinist, for certain improvements in weaving figured fabrics. January 23.

Julian Edward Disbrowe Rodgers, of Upper Ebury-street, Middlesex, chemist, for certain improvements in the separation of sulphur from various mineral substances. January 25.

John Craig, of Stanhope street, Middlesex, gentleman, being a communication from abroad, for certain improvements in machines or apparatus for weighing. February 28.

Edward Bell, of the College of Civil Engineers, Putney, Surrey, Professor of Practical Mechanics, for improvements in applying heat in the manufacture of artificial fuel, which improvements are applicable to the preparation of asphalte, and for other purposes. March 2.

George Bell, of Dublin, Ireland, merchant, for certain improved machines which facilitate the drying of malt, corn, and seeds, also the bolting, dressing, and separating of flour, meal, and all other substances requiring to be sifted. March 2.

James Bullough, of Blackburn, Lancaster, over-looker, for certain improvements in the construction of looms for weaving. March 4.

John Thomas Betts, of Smithfield Bars, Middlesex, gentleman, (being a communication from abroad,) for improvements in the manufacture of metal covers, for bottles and certain other vessels, and in the manufacture of sheet metal for such purposes. March 7.

Jules Le Jeune, of North-place, Regent's Park, Middlesex, engineer, for improvements in accelerating combustion, which improvements may be applied in place of the blowing machines now in use. March 7.

Thomas Howard, of Hyde, Cheshire, manufacturer, for certain improvements in machinery for preparing and spinning cotton, wool, flax, silk, and similar fibrous material. March 11.

Charles Payne, of South Lambeth, Surrey, chemist, for improvements in preserving vegetable matters, where metallic and earthy solutions are employed. March 13.

William Langmaid, of Plymouth, accountant, for improvements in treating ores and other minerals, and in obtaining various products therefrom, certain parts of which improvements are applicable to the manufacture of alkali. March 13.

William Barker, of Manchester, Lancaster, millwright, for certain improvements in the construction of metallic pistons. March 16.

To Joseph Whitworth, of Manchester, Lancaster, engineer, for certain improvements in machinery or apparatus for cleaning roads, and which machinery is also applicable to other similar purposes March 22.

NOTES AND NOTICES.

Common Road Steam Travelling in Denmark.—The *Mining Journal* gives the following as an extract of a letter from Copenhagen dated 4th instant, "Steam-carriages, upon a system newly invented by M. Norrgber, of Sweden, a locksmith and very ingenious mechanician, have been established between this capital and Corsoer. They carry thirty passengers, and have spacious stowage above and below for luggage and merchandise. Their engines are of 8 or 9-horse power, and ascend with ease hills whose angles do not exceed 30 degrees. They travel at the rate of a Danish mile (a little less than two French leagues) in from thirty to forty-five minutes; so that they run to and from Copenhagen, a distance of 14 Danish miles, in about nine hours, while our ordinary diligences, drawn by four horses, take 16 hours to perform the same distance with only 12 passengers and their luggage."

The Comet no Comet.—Mr. Glaister of the Cambridge observatory states, in a letter to the *Times*, that he is of opinion that the brilliant train which has for the last few nights attracted so much attention, is only caused by the unusual brightness of the Zodiacal belt. This may be attributed, he says, both to the state of the atmosphere, and to the approximation of the sun to the constellation Aries. That the atmosphere is in a peculiar state is proved by the circumstance that Venus was seen with the naked eye at noon on the Continent last week. The geocentric movement of the luminous band is evidently northward; this, as all astronomers know, is the apparent motion of Aries. The diminishing brilliancy of the band arises from the gradual recedure of the sun from that part of the Zodiac; or, more correctly, the recedure of that part of the Zodiac from behind the sun, and will, therefore, disappear as the sun recedes.

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SIR GEORGE CAYLEY'S AERIAL CARRIAGE.

Fig. 1.

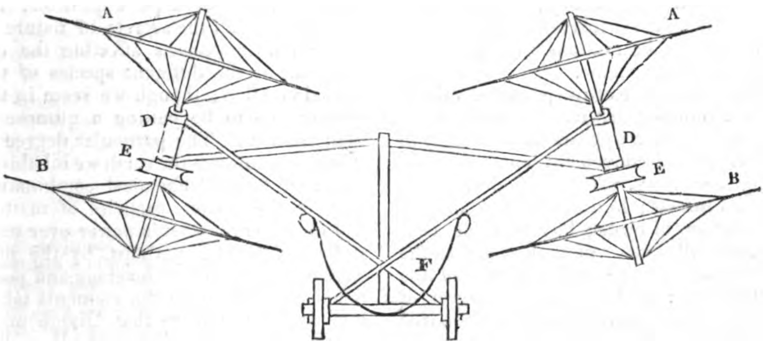
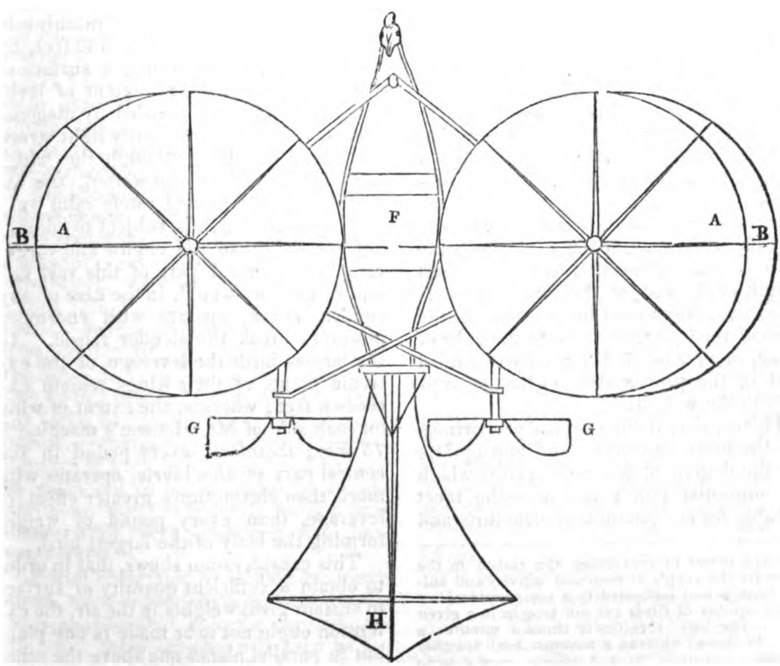


Fig. 2.



ON THE PRINCIPLES OF AERIAL NAVIGATION. BY SIR GEORGE CAYLEY, BART.

Sir,—Mr. Henson having now published a description of the aerial machine with which he proposes to make his experiments, and feeling an earnest desire that success may attend the practical developement of principles which, however difficult in execution, are undoubtedly true in theory; I trust it will not be thought obtrusive in me to state a few leading observations with reference to the present scheme.

The magnitude of the proposed vehicle will, I much fear, militate against its success. There appears to be a limit in nature to the convenient application of winged surfaces. We have millions of winged insects; hundreds of the smallest descriptions of birds; but the eagle, condor, and albatross sail unmolested as the sole tenants of the loftier regions of the atmosphere: and these, the largest of birds, probably never exceed one hundred pounds in weight. Muscular power and animal heat appear to bear a direct ratio to the carbon consumed in a given time by the oxygen to which the blood is exposed in the lungs; and nature seems to have much exceeded her usual animal limits in this respect, purposely to obtain sufficient power for the flight of birds.* The weight of the body of a bird increases as the cube of its linear dimensions, so that if the length be doubled, the weight will be increased eight-fold; and if tripled, twenty-seven-fold. But the surfaces of their wings only increase as the squares of their linear dimensions: hence, in this latter case, if the wings keep the same relative proportion to the increased length of the body as they did in the original size, they would be too small in the ratio of the square of three to the cube of three, or as 9 to 27, being only one third part of the proper size to give due support to the weight.

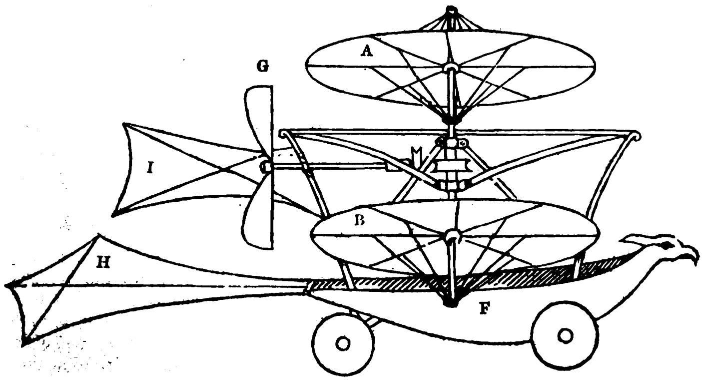
Hence, also, if the original proportions are the most convenient and appropriate for the degree of leverage against which the muscular power can act—the most suitable for compactness of structure, and for the covering and warmth of the body—then these conveniences must be sacrificed to the necessity of giving three times greater surface to enable the bird to fly; and, in the structure of the albatross, it is said there is an additional joint, to increase its extent of wing. It is difficult, perhaps impossible, for man to trace all the secrets of nature as to the limiting causes affecting the dimensions of the different species of the animal creation; though we seem in the present age to be getting a glimpse of such matters. The particular degree of gravitation towards the earth we inhabit—the exact force of chemical combination between the various particles of matter, and of general galvanic power over each and all, modified, perhaps, by the mechanical properties of leverage and position,—probably form the elements taken into consideration by that Divine mind which called all these powers into existence, to fulfil the benevolent purposes of His will. But it is time to return from this digression to the particular case in point.

Mr. Henson proposes the machine to have a lateral extension of 150 feet, by 30 in width; thus forming a surface of 4,500 square feet. The extent of leverage, however well guarded by diagonal braces, is in this necessarily light structure, terrific. For, although the wings are not intended to be wafted, the atmosphere, even in moderately calm weather, near the earth is subject to eddies; and the weight of the engine and cargo, &c., in the central part of this vast extent of surface, would, in the case of any sudden check, operate with enormous power to break the slender fabric. In the largest birds the leverage of the extreme points of their wings seldom exceeds 6 feet; whereas, the extent of wing on each side of Mr. Henson's machine is 75 feet; therefore, every pound in the central part of this fabric, operates with more than eleven times greater effect of leverage, than every pound of weight forming the body of the largest bird.

This consideration shows, that in order to obtain a sufficient quantity of surface to sustain great weights in the air, the extension ought not to be made in one plane but in parallel planes one above the other at a convenient distance, so as to form a

* The power of consuming the carbon in the blood for the supply of muscular activity and animal heat, is best estimated by a comparative view of the number of times one can breathe in a given time.—The horse breathes 16 times a minute; a man, 18 times; whereas. a common fowl breathes 30, and a pigeon 34 times a minute, according to Prevost and Dumas, as quoted by Professor Liebig.

Fig. 3.



more compact fabric, with less extent of leverage. The progressive velocity will prevent these planes from interfering with each other in giving their due support. If, therefore, so large a surface be contemplated for trying this experiment; would it not be more likely to answer the purpose to compact it into the form of a *three decker*, each deck being 8 or 10 feet from the other, to give free room for the passage of the air between them?

This vast surface is all extended in one nearly horizontal plane, which is not the form experimentally proved to give the proper lateral stability to the machine. It was remarked in my last letter, that the surface should be made in the form of the letter V, though of a much more obtuse angle. Extensive principles are often shown by very insignificant means; and every school-boy knows that his shuttlecock, whichever way it may be struck into the air, is never off its balance. Several winged seeds are likewise, on this principle, borne steadily on the air. As very little of the support is lost by this mode of constructing surfaces for aerial navigation, when not carried to excess,—whereas the security of the conveyance is very greatly increased by it,—it ought not to be neglected in an experiment, quite sufficiently fraught with danger after every precaution shall have been taken.

Aerial navigation by mechanical means alone, must depend upon surfaces moving with considerable velocity through the air; but these vehicles will ever be inconvenient, not to say absolutely inefficient, if to effect this they must have an evatleed point to descend from; for, to be of ordinary use, they must be capable of landing at any place where there is space to receive them, and of ascending again from that point. They should likewise be capable of remaining stationary, or nearly so, in the air, when required.

Very great power, in proportion to the weight of the engine, is necessary to answer these, or, indeed, any of the purposes of aerial navigation by mechanical means alone. It is, in fact, the *sine qua non* of the case: and Mr. Henson will deserve great credit if he be able, by any invention of his own, or combination of the inventions of others, permanently to maintain the power of twenty horses, by an engine not exceeding 600lbs. in weight. If that gentleman do not deceive himself in this estimate of the power he proposes to use, well-directed experiments will soon point out the proper mode of its application.

There can be no doubt that the inclined plane, with a horizontal propelling apparatus, is the true principle of aerial navigation by mechanical means, as it is that of the flight of birds; and although it has been fully investigated, and there is nothing new in it, the principle has as yet remained dormant, for want of sufficient power. This principle Mr. Henson adopts, and the requisite power he proposes to supply.

It is not correctly known at what angle with the line of flight the wings of birds are applied; indeed, this probably varies with the comparative size of the wing to the weight of the bird; hence no very

accurate estimate of the power exerted can yet be made; but, from sundry experiments with inclined planes, it seems probable that for every thousand pounds weight of the aerial vehicle, eight or ten horses' power will be required.

The larger the surface in proportion to the weight, the less velocity it requires for its support; and as Mr. Henson's machine is said to have a surface in proportion to its weight exceeding that of most birds, its velocity will not be so great as that of birds. Should he, therefore, fully succeed in his project, the velocity of his flight may be taken at something short of that of the crow, which, in calm air, is 24 miles per hour, and is about the ordinary railroad speed. The direct resistance of the car, masts, and rigging, in the construction of aerial vehicles, will, should they ever succeed, probably put a limit to their velocity not much exceeding 24 to 30 miles per hour.

It has long since been proved, so far as engineering calculations, founded on tolerably well-ascertained data, may be trusted, that elongated balloons, made on a very large scale, and of firm, air-tight materials, may be driven through calm air, by engine-power, at a velocity approaching the railroad pace, and, by their buoyancy, carry, whether stationary or in motion, a considerable cargo. Hence, on a great scale, balloon floatage offers the most ready, efficient, and safe means of aerial navigation.

"The enormous bulk of balloons, as compared with the weight they will sustain, causes the *difficulty* of impelling them, with sufficient speed to be of any utility, either by manual or engine power; and this *difficulty* is by many truly scientific persons considered as insurmountable, because they conceive that the bulk, which causes the resistance, must ever be commensurate with the weight of engine necessary to propel them by any species of waftage—and, consequently, as it will not do on a small scale, that it cannot on a large one. It is true, that it requires twice as much gas to sustain a 4-horse power engine as to sustain one of a 2-horse power (with their loads of fuel and water;) but it is not true that the larger balloon, though perfectly similar in make to the smaller one, will, when driven through the air at the same velocity, meet with *double* the resistance—if it were so, the case of steering balloons would be hopeless, and on this mistaken ground many think it a vain attempt. This idea, resting at the very threshold of the invention, and which seems to present an insurmountable barrier, when probed and fully investigated proves to be false, and the investigation leads to an immutable law of proportion between the resistance and the capacity to carry weight or engine-power, which, on a very large scale, promises the most satisfactory result.

"If balloons of the respective diameters of one and two, both being spherical, be driven through the air with equal speed, the resistance will be as the *surfaces* opposed to the air, and the surface of the largest will be four times greater than that of the smaller, and hence it will require *four* times the engine force to keep up the velocity; but the quantity of gas contained in the larger balloon is *eight* times greater than that in the smaller, hence it could sustain eight times as much engine-power; but four times that power would keep up the required velocity, and hence it could carry a cargo of the weight of its engine, and yet keep pace with the smaller balloon. The simple terms of the case are, that the surfaces (and hence the resistances) increase as the *squares* of the diameter of the balloon; whereas the capacity to contain gas (and hence the supporting power) increases as the *cubes* of the diameter.

"From this *unquestionable* law it follows, that if similar shaped balloons vary in diameter as the numerals 1, 2, 3, 4, 5, &c., the resistance they will meet with in the air, at the same velocity, when compared to the weight (or engine-power) they will sustain, will be as 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c. This is a most important fact, and proves that as the law of relative diminution to resistance is *unlimited*, there must ever be, *theoretically*, some bulk in which any species of first mover, however sluggish in proportion to its weight, would find itself suspended, and its power adequate to propel that bulk with the velocity required."*

Elongated balloons, of large dimensions, thus offer greater facilities for transporting men and goods through the air, than mechanical means alone, inasmuch as the whole weight is suspended in the air without effort; and when the invention is realized, it will abundantly supply the increasing locomotive wants of mankind, for which, in due time, it was probably designed. Mechanical flight seems more adapted for use on a much smaller scale, and for less remote distances; serving, perhaps, the same purpose that a boat does to a ship, each being essential to the other.

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* From Practical Remarks on Aerial Navigation, by the author of the present article, in *Mech. Mag.* for March 4, 1837.

One great difficulty to be overcome in mechanical flight, is the enormous difference of the powers required to perform it, as birds do, by any direct downwards waft in the first instance, as compared with the skimming action on the principle of the inclined plane. The surface of a square foot if loaded, as it is in the crow, with a pound weight, would descend perpendicularly with a velocity of 21 feet per second; hence, to sustain his weight, he must press his wings down with that velocity, which is equivalent to lifting his own weight 21 feet per second. Now, if an aerial machine were to weigh 1000 pounds, and it had to be lifted with this velocity, the force required would be that of 38 horses; and Mr. Henson's engine, if loaded in the same ratio, would be a 114 horses' power. The bird even exerts a still greater effort, for he has, in the downward beat, to make good the time lost in the ascent of his wing.

The crow, in skimming, goes about 36 feet per second; during which time, if unaided by any waft to propel him, his descent will be about one eighth of 36, or 4½ feet. The power required, therefore, cannot be greater than in the ratio of 4½ to 21; and in this case 1000 would, in the skimming action, require a 8¼ horses' power to maintain it, provided it were performed as in birds, by the surface being moved downwards, when obliquely raised at the hinder portion, so as to continue during this action, the same force of the air applied under the surface, as when the front portion of it is elevated, and the bird skims for a time by its previously acquired momentum. It is not yet ascertained what the actual angle of the bird's wing is, and the absolute power required for propelling aerial vehicles, cannot therefore be stated with certainty, though we thus make some tolerable approximation to the truth.

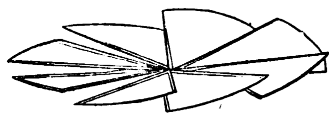
The capacity of varying the degree of power to so great an extent in muscular action, gives much greater facility to the flight of birds than man possesses in his steam power, the uniformity of which obliges some more uniform course of action to be adopted.

Under this general view of the case, I have endeavoured to combine all the requisite principles of action that have been enumerated. Figs. 1, 2, and 3 will exhibit, without tedious explanation, the construction of an aerial vehicle, containing about 530 square feet of surface. Fig. 1 shows an end view in elevation; fig. 2, a bird's-eye plan; and fig. 3 a side elevation.

The main surfaces A A, and B B, are here placed one above the other, and each pair are connected together by strong shafts, firmly fixed into sockets at each end of a steel axis, which turn freely in their collars D D. These shafts carry a spiked pulley or drum E E, by which they may be turned by a pierced belt, or chain, from the engine in the car F.

The construction of these circular planes is such, that when only required as a stationary expanse of surface, they continue in one even, or rather slightly curved state, like a very flat umbrella; but when the engine power is applied, to make them revolve in their proper directions, one set adverse to the other, they are immediately, by that act, thrown open, into the form of the flier, fig. 4, and thus the surface, to a great extent, is made to skim, though the machine may be stationary—the upper edge of each section in these fliers being foremost.

fig. 4



It must also be observed, that the two sets of fliers are placed in the obtuse V form, to ensure lateral steadiness to the machine. These may be termed the elevating fliers, to distinguish them from two other smaller ones G G, set at a very different angle with their axis, and used for propelling the machine, when the others are stationary; both sets will be put into action gradually, or in any required degree by friction plates, as is usual in such cases.

If the elevating fliers have a diameter of about 11¼ feet each, they will contain about 100 square feet of surface; yet by this construction, the leverage of the centre of their support, on each side, will only be about 8 feet from the centre of the car, and this will be firmly sustained by the diagonal bracing of the framework.

The framing is also adapted to increase the stationary surface, by being covered with canvas in the obtuse V form down to the edge of the car, and overhead, like a very flat roof, to keep off rain, &c. This surface, as here shown, would be about 130 feet, but, by the addition of a couple

of light yards, as in the sails of ships, it might be much increased, with little additional weight.

The broad horizontal rudder, or tail, H, capable of being turned on its hinge to any angle, at pleasure, gives the power of ascent and descent when the propellers are used, and forms also the chief means of stability in the path of the flight.

The small vertical rudder I, is for the purpose of lateral steerage, in combination with the two propellers, which, by being used singly, will turn the machine with great power; and if one be reversed by the sume means as those now used for steam paddles, a still greater lateral guidance can be obtained.

This construction of an experimental machine for mechanical aerial navigation is not offered in the light of a finished model; but more to show, in combination, certain principles which must be attended to in their construction, to give them a fair chance of success. It will give me much pleasure, if anything experience may have taught me on this subject, can be turned to any account in the present project, which Mr. Henson has now made his own by patent right. I am, however, of opinion that balloon navigation is that designed for the uses of mankind, on the large scale; but as this letter has already far exceeded its due limits, I must refer such of your readers as may choose again to examine the capabilities of balloon floatage, to an article in No. 708 of your Magazine for 1837. I think it is a national disgrace, in these enlightened locomotive times, not to realize, by public subscription, the proper scientific experiments, necessarily too expensive for any private purse, which would secure to this country the glory of being the first to establish the dry navigation of the universal ocean of the terrestrial atmosphere.

I remain, Sir,
Your obliged and obedient servant,
GEORGE CAYLEY.

Hertford-street, April 2, 1843.

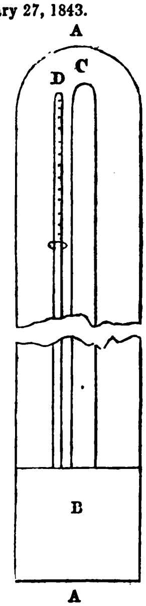
BAROMETERS.

Sir,—I have read in some of your late Numbers an account of Mr. Readman's patented barometer, and the claim of priority set up by Mr. C. T. Coathupe, of Wraxal. In Mr. Readman's there appears to me a great deal of unnecessary complexity, and Mr. Coathupe does not seem to be aware of the great nicety required in the comparative measurement of the cistern and tube required to ensure correctness.

I have been in the habit for the last ten years of registering by a barometer of my own construction. The tube, which is of ½ inch bore and 34 inches in length, is placed in a mahogany frame and cistern. A cover on the surface of the mercury in the cistern sustains and floats a rod of lancewood, the whole length of the tube, and being measured in inches and tenths from the bottom, indicates correctly the height of the column from the surface of the mercury in the cistern, without calculation or trouble. Nothing, I conceive, can be more simple and correct than this. I subjoin a sketch and description of the instrument. I am, Sir, yours, &c.

J. F. BARNARD.

Bath, February 27, 1843.



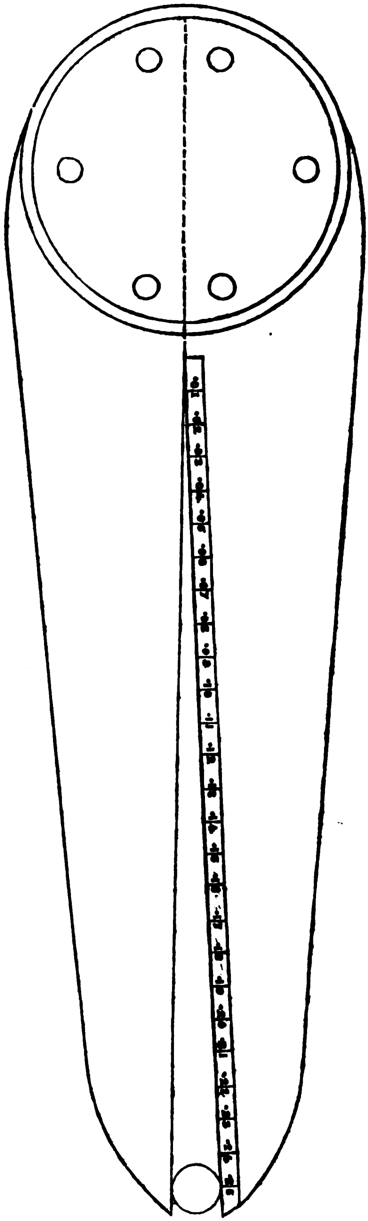
Description.

A A, mahogany frame; B, cistern, with sliding cover; C, tube, with column of mercury; D, graduated wooden rod, passing through a hole in the sliding cover, and resting on a card, floating on the surface of the mercury in the cistern.

P.S. I understand that barometers, precisely on this principle, have been used for some time, at Greenwich, and other public observatories.

STANDARD WIRE-GAUGES.

Sir,—This subject has lately been discussed in your Magazine by three different parties. The first brings forward what is not *new;* though that is no fault, as we are all the better for being reminded of what we have heard before, and forgotten. By referring to No. 55 of your Magazine, the identical gauge will be there found described; and also in "Lardner's Cyclopædia," 2nd vol., on Manufactures in Metal, page 347. This gauge was invented *first* by a Mr. Aitkin, I believe, and he obtained a prize from the Society of Arts for Scotland for it. The Editor of the Cyclopædia, though he must have had the inventor's name before him when copying the article, has not thought proper to mention it; and the objections which he and your correspondent, "K. H.," bring against it are not correct. The description given by the inventor states, that "all that is required is, to take two straight rulers, of any convenient length, to make their edges touch at one end, and to separate them *near* the other by a cylindrical or spherical body, of half an inch diameter. If the rulers be unalterably fixed in this position, and the space lying between the *points of contact* with the cylinder at one end and of the rulers at the other be divided into fifty equal parts, and numbered from 50 to 0, then the divisions will show *the diameters* of wire in $\frac{1}{100}$ths of an inch. If the dispart, instead of being ·5, be made ·05, then the divisions will show thousandths." Dr. Lardner says—"This gauge will not ascertain the full and exact diameter of the wire at the *tangible points* of the two sides of the gauge; which circumstance must, indeed, be apparent, on inspection of the preceding cut." Your two last correspondents fall into the same error, and, in consequence, have given themselves useless trouble in devising "*improvements*," (?*additions*, which are not *improvements*,) as Aitkin's gauge is *quite perfect* without them. You are aware that I consume no small quantity of wire in the course of a year; and as it is necessary, for the perfection of our manufacture, that the wires should all be of exactly the same size, I found this could not be obtained by using the common gauges, which are the most absurd things ever made. I, consequently, use Aitkin's gauge, and find it most perfect. I had it made as in the following sketch (full size.)



A cylinder ·25 of an inch is used as the starting point in some, ·5 in others, and ·1 in others. If ·25 is used, the *tangible point* is numbered ·25, and from

that to 0 is divided into 25 parts. Number ·10 indicates $\frac{1}{10}$th of an inch, that is, a wire ·10 of an inch *in diameter* will enter the gauge as far as number 10, and so on; so that there is no need of any sliding scale. The gauge is so correct, that I can detect a wire which is not *perfectly* cylindrical. I prefer having them open at the points, so that a bundle of wire may be gauged at any part: if the gauge is closed at the points, the *end* of the wire must be used, and either end is seldom the same as the middle of the piece.

"K. H.'s" gauge for holes is equally old with the above gauge: they may be found in use in many manufactories.

It is better to have two gauges, one from 0 to ·25, and another from ·25 to ·5. If only one is used, from 0 to ·5, it must either be very clumsy and unhandy, or the distance between the numbers must be small, which are objections. There is no difficulty in distinguishing the point where a wire touches the scale.

I have one or two designs for pocket gauges, on this principle, which I may send for insertion ere long. If wire drawers and consumers were once to try these gauges, they would soon discard the old ones.

Yours, &c.,
FIL DE FER.

Gateshead, March 17, 1843.

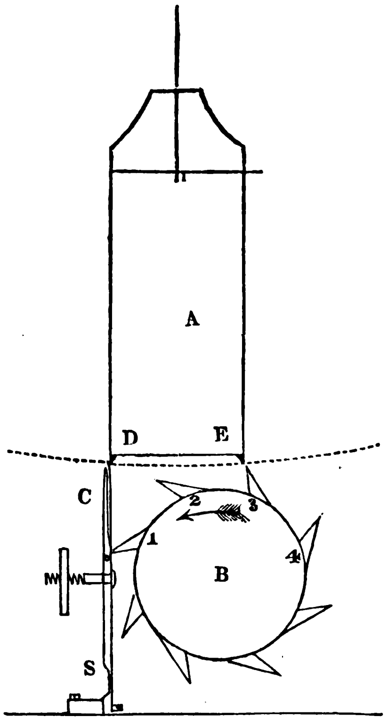
P.S.—Different kinds of scales may be put on the gauge: a very useful one is the *area*, which also gives the comparative *weights*, a circular inch being the unit.

PENDULUM ESCAPEMENTS.

Sir,—An eminent writer upon horology observes, that "if an escapement could be contrived which gave its impulse to the pendulum at the middle point of its vibration, and was wholly detached from it at all other times, such an escapement would be perfect, and that escapements are almost to be considered good or bad as they approach this character."

The ordinary chronometer escapement, invented by Earnshaw, and for which he received a reward of five thousand pounds from the Admiralty, fulfil these conditions more nearly than any other, and as "this escapement stands unrivalled for simplicity and for performance," it is probable that considerable advantage would be derived from its application to the astronomical clock, which appears to me may be effected in the following manner.

Fig. 1



A, the pendulum, the lowest point of which describes the arc, represented by the dotted line.

B, the scape wheel, turning in the direction of the arrow.

C, the ordinary chronometer detent, with discharging spring, locking stud, &c., the centre of motion being at the spring S.

D, the discharging pallet under the pendulum.

E, the main, or impulse pallet, with a notch cut across it, to admit of its passing and repassing the discharging spring of the detent without touching, both pallets being formed of jewels and fixed to the pendulum.

The discharging spring D, when the pendulum vibrates to the left, presses against the discharging spring, which

bends the detent to the left, and unlocks the scape-wheel by drawing the locking stud from the point of tooth 1; the wheel turning round tooth 3, rises above the dotted line and gives the impulse by striking the main pallet E; tooth 2 then falls on the locking stud of the detent, and the scape-wheel is again locked, the pendulum continuing its vibration to the left; the main pallet E, by means of the notch, passes the discharging spring without touching. Upon the return of the pendulum the main pallet E passes without touching; the discharging pallet D bends the discharging spring to the right and passes without disturbing the scape-wheel, which remains locked until the discharging pallet D, upon the pendulum again vibrating to the left, strikes against the discharging spring.

The pendulum makes two vibrations for each impulse, and to note seconds on the dial, the half-second pendulum must be used.

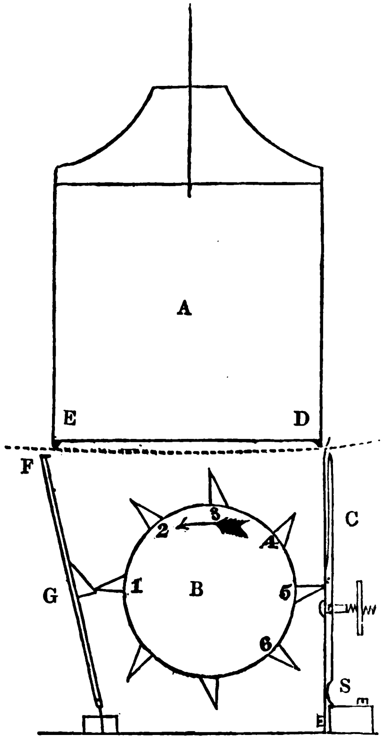
Experience having so fully proved the value of the ordinary chronometer escapement, I have been desirous of maintaining its integrity as far as circumstances will admit in its application to the pendulum, but I consider figure 2 by far the best escapement in cases where a short pendulum only is admissible; it is upon the remontoire principle, the impulse being always *very nearly* of the same force.

The pendulum, scape-wheel, detent, discharging and main pallets, are similar to those before described.

F G H, a lever of the third order, a side view of which is shown at fig. 3, the fulcrum being at the springs H, the power being applied through the teeth of the scape-wheel to the lever-pallet G, and the resistance being at the hammer F.

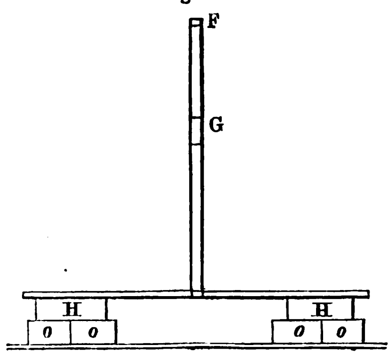
The pendulum vibrating to the right, the discharging-pallet D unlocks tooth 5 of the scape-wheel; tooth 1 escapes from the edge of the lever-pallet, the lever by the action of the springs H assumes a perpendicular position, and communicates an impulse by striking the main pallet with the hammer F; tooth 2 falls on the lever-pallet G, and forces the lever backwards into the position represented in the figure, until tooth 6 falls on the locking stud of the detent—tooth 2 remaining on the edge of the lever-pallet, the main pallet E, by means of the notch passing the discharging spring without

Fig. 2.



touching. Upon the return of the pendulum to the left, the action described in fig. 1 takes place, the main pallet E passing without touching the discharging spring, which is bent to the left, without disturbing the scape-wheel by the discharging-pallet D, both pallets just clearing the hammer head of the lever.

Fig. 3.



In figure 3, F is the hammer head; G, the lever pallet; H H, the lever springs pinned to two studs on any convenient part of the clock-frame. A motion backwards and forwards may take place, but none sideways.

Fig. 4.

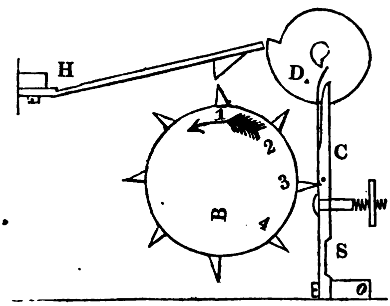


Figure 4 represents the remontoire lever in fig. 2, applied to the ordinary chronometer escapement.

B, the scape-wheel; C, the detent; D, the discharging pallet; E, the main pallet placed nearly at right angles to the discharging pallet, and just clearing the hammer head of the lever, both pallets being fixed as usual on the arbor of the balance; F, the hammer head of the lever; G, the lever pallet; H, the fulcrum spring.

The balance with both pallets vibrating to the right, the discharging pallet D releases tooth 3 from the locking stud; tooth 1 escapes from the edge of the lever-pallet, and down comes the lever hammer-head F on the main pallet E, to which it communicates a sharp tap without any scraping or rubbing; the scape-wheel turning round tooth 2 raises the lever by pressing against the lever-pallet G, until the wheel becomes locked by tooth 4 falling on the locking stud, tooth 2 remaining on the edge of the lever-pallet: the return action is the same as previously described.

The advantages of this escapement consist in the impulse being communicated by a smart tap or knock, instead of the scraping action of the teeth of the scape-wheel on the main pallet; in being always very nearly of the same force, the only cause of variation being the relaxation and loss of elasticity from use in the fulcrum springs H; and in making the scape-wheel turn in the direction of the arrow. The detent spring S may be made of the most slender dimensions, far more so than if the scape-wheel had to turn as usual in the opposite direction.

I am now fearful of trespassing on your valuable pages, but shall be happy, should you desire it, to send you a description of a "double escapement," applicable to the second pendulum, which possesses some advantages over the single one (fig. 2), with some general remarks applicable to both.

I am, Sir, your obedient servant,

W. B. Hunt.

Custom House, London,
February 28, 1843.

[We shall be glad to receive the further communications obligingly offered by Mr. Hunt. Ed. M. M.]

SIMPLE METHOD OF EFFECTING THE SEPARATION OF THE RESIN IN GAMBOGE.

Sir,—As the separation of the coloured resin from gamboge has been looked on as of very "difficult attainment" both the gum and resin being equally soluble in spirit of wine), I take the liberty of informing your numerous readers of a very easy process of accomplishing the object. It simply consists in allowing the gamboge to remain *undisturbed*, for about a fortnight, in a vessel along with a little water. The water gradually abstracts the gum, leaving the resin in light flocks, not near so miscible in water as the gamboge itself. It is my intention to isolate, in a solid form, the colourless gum, in order to try if the yellow resin in the natural substance can be replaced, with good effect, by another of a different colour; for instance, that of Dragon's-blood, Saunders-wood, alkanet-root, or, indeed, any that may have the property of being dissolved by alcohol or pyroxylic spirit. One of my plans will be, to dissolve, in proper proportions, the gum and resin, then to evaporate till a dry mass is obtained. As soon as I make the necessary experiments, I will forward to you the result, should it turn out favourable.

Believe me, Sir, yours respectfully,

M. Dambeger.

March 20th.

THE LEYDEN JAR IMPROVED—ELECTRIC IGNITION OF GUNPOWDER.

Sir,—While lecturing on electricity, I have been frequently annoyed by the uncertainty of the Leyden jar, and the difficulty of igniting gunpowder, on all occasions. I think the first is overcome by placing an earthen jar, full of hot sand, inside the jar; by this contrivance, I have succeeded on very damp days.

With respect to the ignition of inflammable compounds by frictional electricity, I use, instead of gunpowder, equal weights of chlorate of potash, and sulphuret of antimony, which, being a detonating or fulminating compound, should be reduced to powder *separately*, before they are mixed. For security, the weight should not exceed 20 grains. In this experiment the glass tube, containing water, need not be employed, as with gunpowder. I am not aware that the above facts are already known. I am, Sir,

Yours &c.

WILLIAM LOVER.

Dublin, 56, Amiens-street.

ON THE MANAGEMENT OF COMMON BEE-HIVES.—BY THE REV. WILSE BROWN.

Sir,—The following plan for managing bees in common straw hives, so as to obtain a portion of honey without destroying them, may interest some of your readers, if you think it worthy a place in your valuable Magazine.

Put a swarm into a hive, with a hole in the top, closed with a cork. Nail a piece of wood 4 inches long, 3 wide, and ½ an inch thick, on one side of the hive, at the bottom, cutting a hole 1 ½ inch long, and ½ inch high, through the lower edges of the wood and hive. Attach a similar piece of wood to a second hive, and insert a pipe of tin, full of small holes, through the top of this hive. The pipe may be made by simply bending half a sheet of tin round a roller 2 inches in diameter, nailing the upper end into a ring of wood, and closing the bottom with a wooden plug. The wooden ring must be outside the hive, and must have a wooden cover. It is intended by this pipe to ventilate the hive, and its size allows a thermometer to be kept in it.

Place both these hives, with the pieces of wood in contact, on a board 1 inch thick, 3 feet long, 18 inches wide, inserting a slip of tin between the pieces of wood to cut off the communication between the hives.

The most effectual protection to the hives, is given by a well painted canvass cover 1 yard square, nailed in front and back to wooden rods. In this cover, holes about 4 inches in diameter should be cut to correspond with the pipe and cork in the top of the hives. A canvass cover, made like a cone, nailed to a knob of wood at the top, and sewn to a thick iron wire at the base, must be placed over each hole in the large cover. White paint must be used, as it does not attract the heat. The great expense of bee boxes, (far beyond the means of cottagers,) led me, Mr. Editor, to contrive the above plan in the spring of 1842; it costs about 8 shillings, and can be executed by any person.

I will now state the success I had with it last summer.

In April, 1842, I fitted a hive of bees, swarmed in June, 1841, with the second or store-hive, and marked it A.

One swarm came off, which was fitted up in the same manner, and marked A a.

About the middle of July the bees were allowed to enter the hives at the side, the breeding-hives being nearly full.

In the middle of September I inserted the pieces of tin again between the hives, by which I confined in the store-hives all the bees that were in them.

I then opened a door into the air from each store-hive, which I covered with a thin slip of wood, with a hole in it large enough to allow one bee to pass at a time. Over this hole I hung by a thread on the outside, a piece of talc. The bees pushed the talc open, as they made their escape, but could not get back again into the hive.

In the course of a few hours all the bees, except twelve, had escaped, and returned to the breeding-hive in A a.

The queen was in the store-hive of A, and consequently I was obliged to smoke the bees out; many died, but the queen survived, and was replaced in the breeding-hive.

From A a, I obtained 16lbs. of the finest honey, free from young bees, or bee-bread, without killing a single bee.

From A, I obtained 10lbs. of honey, equally pure and good with that from A a.

The trap-door of talc was a contrivance

of Mr. Nutt, the author of the interesting work on bees.

I remain, Sir,
Your obedient servant,
WILSE BROWN.

Egglestone, Barnard-castle, March 31, 1843.

HINT FOR INCREASING THE EXPLOSIVE POWER OF GUNPOWDER.

Sir,—Making an attempt one day to prepare some gunpowder, I found that, by following the recipe I had procured, nothing like a good article was produced; in fact, the preparation would not go off with the quick flash and report which always attends the firing of even the very commonest kinds prepared by the regular makers. However, I bethought myself of common tinder made by burning rags, which is well known to be very highly inflammable. Thinking it might prove more serviceable than charcoal, I tried it, and the result of the change far exceeded my expectations. The cause of the great combustibility of tinder appears to be the comparatively short exposure to heat it has undergone in the making: and the result of some experiments on charcoal, performed by able chemists, was, that when that substance was exposed, in close vessels, to heat for a length of time, it had lost nearly all its inflammability, becoming merely red-hot when an attempt was made to ignite it. I have sent this brief account for insertion, under the hope that, through it, some improvement may be made in gunpowder when in the hands of some skilful manufacturer.

I am, Sir, your obedient servant,
D. L. GUIGNARD.

PILBROW'S DISCOVERY IN STEAM POWER.

Sir,—I find that I have used the term "hydrodynamics" at p. 268 of my last paper, instead of "hydrostatics." The distinction is not unimportant; because, when steam, or air, under pressure, is flowing through pipes of *discharge of the same area throughout*, however great the pressure may be at one end, the density must necessarily be materially decreased at the other, owing to the expansive velocity travelling so much quicker than the initial velocity. Yet, though there be this diminution of pressure, not the mightiest hydraulic press worked by the mightiest power can, as I have shown before, by "concentration of the current of steam," or "by the contraction of the area of escape," or by any other means, *increase* the pressure at one part more than at another. The writer of the note on my paper cannot but see, therefore, that this assumption of his, being an impossibility of science, is wholly inadequate to account, as he asserts at p. 269, for "the extra pressure indicated at the point of the nozzle." A gauge placed there would show precisely the same pressure as that in the boiler, provided the supply-pipe was sufficiently large to keep the nozzle at that pressure. It would probably indicate less pressure, just in proportion as that supply-pipe was insufficient for this purpose, but never could it possibly show a greater pressure, much more double.

The writer of the Note at p. 269, only gives me fair credit for discrimination, when he observes, that I have "altogether evaded" addressing myself to the perpetual motion affair which he has now made of Mr. Pilbrow's discovery at page 269. All I advocate is the great discovery which *he* (Mr. Pilbrow) has made as described in his own unmistakeable language, in the extracts from his specification, given at p. 240. And I must *still* "evade altogether" discussing the said perpetual motion idea of the writer of that Note.

In the 2nd col. of p. 269, the writer says "Scalpel's language *shows clearly*, that according to *his* view of matter *velocity has nothing* to do with the production of these effects."

Scalpel's language, however, in the *opposite* page, will be found to be just the reverse:—"the extraordinary effect of the pressures given at p. 242, can, I think, ONLY be accounted for BY the *expansive* VELOCITY of the steam"!

Mr. Watt's authority of "double effect" in steam from the same cause, will, I hope, be treated with more respect than mine has been. In explaining his discovery of the expansion of steam to Dr. Small, he thus writes in a letter dated the 28th of May, 1769:—"I mentioned to you a method of "still doubling the effect of the steam." Mr. Watt then describes the principle, which is too well known to copy, and gives this result:— "The sum of the series you will find

greater than one-half, though only one-fourth steam was used." Yet the reviewer of Mr. Pilbrow's discovery ridicules at p. 243 the idea of "the expansive force of steam" giving any power above that in the boiler, although it is most apparent, from the very nature of steam, that the whole force from velocity is derived solely and entirely from its expansibility; just as Mr. Watt "doubled the effect of the steam" in *his* way. "To expand steam," then, "is" *not*, as the reviewer there states, "notoriously to *weaken its power*." Nor is it, as he further states, "when we talk of gaining by working steam expansively, *all that is meant is*, that it is worked more economically." Give it room to increase its power, that is to expand, and instead of "weakening its power," it is, in the language of Mr. Watt, "a method of still *doubling* the effect of the steam." To say more on the point, after three quarters of a century have passed since this discovery was made, would indeed be a waste of time, and unworthy of the knowledge of the age.

Here let me point out the remarkable confirmation, in Mr. Watt's letter, of Mr. Pilbrow's discovery. From one-fourth of the quantity of steam at the initial, or boiler pressure, Mr. Watt obtained more than one-half. From the initial pressure in the boiler Mr. Pilbrow shows, by the table given at p. 242, that he also gets more than double. Thus, from exactly the same cause, expansion, both "still double the effect of the steam," though by totally opposite ways. Now, must it not ever be considered one of the most remarkable facts in the whole range of science, that it never occurred to the mighty mind of Mr. Watt, whether the power and duty due to the expansibility of steam might not be obtained by some more simple means than by expansive gear to cut it off, and the other complicated machinery now used?

If there be any truth in deductive philosophy, we have only to follow into their ultimate consequences these two classes of fact, the same in results, yet so differently arrived at, to be able to predicate, without failure, that the *duty* of both engines *must* be the same. This alone is the grand criterion of the value of any improvement or discovery in steam. Now, I will place on record my opinion, *à priori*, to be determined hence by experience, that the application of the power of steam, by its mere expansive velocity, must, *ex necessitate rei*, do as much duty as the best Cornish engine, the pressure, boiler, clothing, and stoking being alike. The great fundamental principle of the variation and measure of power—momentum multiplied by velocity—is here our guide. Mr. Watt derived his chief power and duty (not from velocity, but) from expansion over large areas, and gained in pressure what he lost in velocity. Far more simply, because more in accordance with what is now found to be the *real* condition of steam power, Mr. Pilbrow derives his chief power and duty from the simple expansive velocity of steam, (not from expansion over large areas,) and he will gain in velocity what he loses in pressure on surface. The duty of each will be the same; that the greatest which consumes the least power, for friction and other deductions, in transmitting the remainder to account; so that if this be in favour of Mr. Pilbrow's engine, it will assuredly do more duty than even the best Cornish lifting engine, the other circumstances being the same. It seems to me, indeed, a self-evident deduction, that, now that "the *proper* effect or force due to the expansive velocity of steam" is discovered, any given quantity of steam *must* do as much work by its simple velocity, when turned to the best account on Mr. Pilbrow's principle, as it can perform in the best reciprocating engine.

I cannot pass, without declaring my admiration of the clear and beautiful chain of reasoning by which Mr. Pilbrow arrived at his great discovery. It is expressed, too, in the simplest language of philosophy, and adds another to those instances which have been so eloquently extolled by Sir J. Herschell, and pronounced by him, "the very triumph of theories." "The failure of my plans," says Mr. Pilbrow, (p. 240,) "to obtain these results, (the duty from expansion with Hero's engine,) disclosed to me the remarkable fact, that a current of steam in rapid motion, that is, issuing from an orifice, loses, almost entirely, that power of *lateral* expansion which it possesses when cut off, and allowed to expand from a state of comparative rest. When I had confirmed *this* phenomenon by other experiments, I was satisfied that steam possessed an impulsive power of the utmost

efficiency, entirely different from what had ever been supposed; for, its *full expansive force not being given out laterally*, MUST HAVE GONE SOMEWHERE, *and, as it* COULD ONLY *expand in the line of its issue*, I became acquainted with this new and singular property of steam, that it possessed, in its mere velocity alone, a propulsive force from its lineal expansibility, equal in power and duty to the gross effect obtained when cut off and allowed to expand under the best circumstances." I tried it, he says, and it was so. Acquainted, I believe, with nearly all the predictions of theory, I know not one, except that of Columbus, which has been more truly and importantly verified. Nor do I hesitate to place its philosophy, and the sober and simple language in which it is explained, upon a level with that reasoning which led Mr. Watt to invent his separate condenser. Others will have their opinion. I simply desire, in this state of things, to express my own.

SCALPEL.

April 3, 1843.

["Scalpel states, as his reason for having evaded, and still evading, the question as to the power alleged by Mr. Pilbrow to exist "in mere velocity alone," that we have made "a perpetual motion affair" of it. We do not understand what he means by this; but, if he means to insinuate that we have misrepresented Mr. Pilbrow's theory, in the least, we deny that we have done so, and challenge him to prove what he insinuates. We further challenge him, once more, to make it comprehensible to any intelligent being, how there can be any such power in "mere velocity alone." "Scalpel" himself now tells us, that it "must be apparent that *the whole force* from velocity is derived solely and entirely from its expansibility;" that is, the expansibility of the steam. Exactly so; the force of expansibility, or elastic force, is the only force in the case, *be the velocity what it may*; and that force is in an exact ratio to the temperature and density of the steam. But what then comes of Mr. Pilbrow's doubling of the power from "mere velocity alone?" And what becomes of "Scalpel's" own equally original and entertaining notion of the doubling of the power from the "force of reversal?" By the bye, why is it that we hear no more of this wonderful discovery of the "force of reversal?" Is it abandoned already—as soon, almost, as it had birth? The contraction of the escape-pipe at its extremity, "Scalpel" still insists, has nothing to do with the proportional increase of pressure exhibited by Mr. Pilbrow's experiments. If this be so, then, as we said before, *why contract it?* "A gauge," he says, "placed at the point of the nozzle would show precisely the same pressure as that on the boiler, *provided the supply was sufficiently large to keep the nozzle at that pressure*;" that is, in other words, the pressure will remain the same at the nozzle as in the boiler, *provided it is kept so!* It required no "ghost from the dead," nor yet any scraper of dead men's bones, *scalpel* in hand, to tell us this. But can any thing be plainer than that, if a body of steam, rushing out through a one-inch pipe, is suddenly restricted to a half, or fourth of that space, the pressure on that half or fourth must be greater than it was before? Mr. Pilbrow has found this to be the case; but, overlooking the cause, he ascribes the increase to the power which he absurdly fancies to exist "in mere velocity alone." The attempt to drag in the great authority of Watt, as being favourable to Mr. Pilbrow's theory, is most unwarranted. The context of the letter which "Scalpel" quotes in so partial a manner, and paraphrases so loosely, is, in fact, in positive contradiction to it. All that Watt contends for in it is, that the elastic force of steam may be turned to more than double account, by using it expansively: *not one word of doubling or increasing the elastic force itself*,—which is manifestly quite another thing. There are several other points in this controversy which we feel strongly tempted to advert to; but they are so well handled in the letter which follows, from another correspondent, ("Probe,") that we forbear.—ED. M. M.

MR. PILBROW'S "DISCOVERY IN STEAM."

Sir,—Surprising as it is, that in the present advanced state of our knowledge of the

properties of steam, so monstrous a fallacy as Mr. Pilbrow's "new discovery" should be gravely promulgated, I confess it is to me a matter of still greater surprise that it should have found a volunteer champion in the once, but (may we not say ?) no longer redoubtable "Scalpel." Well may his mind have been troubled with visions of what the Illustrious Watt would have thought and said of it, had he been living in our day. THE WATT whom he has erewhile praised so justly and so eloquently in your pages, but whose memory he now (most unwittingly, I am bound to believe,) insults by the supposition that he would have subscribed to so gross a heresy.

What is this heresy? In effect briefly this, that you can get more power out of a boiler, than there is in it—ay double the power! If you will but let Mr. Pilbrow draw off the steam in a way he has got of his own, he will make every cubic inch equal (at least) to two. So that ere long (if "discovery" goes on at this rate) we may hope to see the pint pot made to hold a quart.

Mr. Pilbrow says it all comes of the velocity with which the steam is emitted from the boiler. If this were true, then it should follow that the greater the velocity the greater the increase of power; so that, supposing a velocity represented by a were to double the power, then a velocity of a^2 would quadruple it. Absurdity on absurdity!

"Scalpel," on the other hand, (mistaking, as you have clearly shown, the doctrine he has undertaken to defend,) tells us that it all comes of the "concentration" of the steam. But "concentration" is not multiplication. Concentrate as you will, you cannot *thereby* add one atom to the matter concentrated.

"That a current of steam or water," says "Scalpel," "directed against a flat plate will give out only half of the force it would deliver into a cavity, is obvious." Admitting this, for the sake of argument, to be true, still there is but one-half lost in the former case, and that same half saved in the latter, and nothing more than the whole quantity delivered at last. Whence then comes the pretended increase? From the "force of reversal," quoth "Scalpel"! "By reversing," he says, "the *whole* motion you also obtain the additional force of reversal, and so double the effect"!! Greater nonsense than this—more palpable, more egregious, more fantastical nonsense than this—on a mechanical subject I never read. If there were any such "force of reversal" as "Scalpel" talks of, why be content with so little of so good a thing? Why not have a second cavity, and so double the effect twice over? Why not a third, a fourth, a fifth, or indeed any number of cavities you please in zig-zag succession, since increase does but come of reversal, and the more reversal the more increase?

Both Mr. Pilbrow and "Scalpel" seem to have a confused notion, that as bodies falling downwards through space acquire additional force from falling, a body of steam projected horizontally ought also to acquire additional force from moving forwards. When they have penetrated a little further into the mysteries of nature—a very small way beyond the surface will suffice—they will discover that there is no analogy whatever between the two cases. Gravity, which is the multiplying force in the one, has no place in the other; except it be to depress, and retard the body in motion. As in gunnery, the only propelling force is the elastic vapour produced by the ignition of the gunpowder in the cannon, and the ball loses force with every inch it advances beyond the cannon's mouth; so in horizontal currents of steam, the only impulsive force is the pressure in the boiler, and the greater the distance of the point against which the steam is directed, the less is the force (velocity and every thing else notwithstanding) with which it ultimately impinges.

Most practical men (such as take Watt and common sense only for their guides!) are of opinion that the sooner you let in the steam to do its work upon the piston, and the hotter you keep it till the work is done, the better; but according to Mr. Pilbrow's new theory, the longer the course which the steam has to take, providing always the point of maximum velocity, wherever that may be, is not exceeded, and the more opportunities it has of parting with its heat, the greater the economy!

The truth is, (though neither Mr. Pilbrow nor "Scalpel" may be able to see it,) that they but expend on the production a high velocity *to no purpose*, that force which other (less enlightened!) people turn *to excellent purpose* by applying it directly to the body to be put in motion.

"Scalpel" dwells, with a complacency which, under the circumstances, is irresistibly ludicrous, on the "beautiful harmony" which prevails between Mr. Pilbrow's "discovery" and all the known laws of nature. It would be amusing, if not instructive, if he would inform us, in a few plain words, what those laws are with which it harmonizes so beautifully. I mean, of course, *Mr. Pilbrow's* discovery of the power which exists "in mere velocity alone," and not "Scalpel's" discovery of the "force of reversal," of which it is needless to say any thing more, and the less said (for "Scalpel's" sake) the better. From all that has yet appeared, there is not a single law of nature, having any relation to

the subject of steam power, to which it is not diametrically opposed.

I owe you, Sir, and your readers, some apology for having said so much as I have done on the subject; because, after all, I feel sensible that I have placed it in no clearer light than it was placed already by your own unanswered and unanswerable observations upon it. My reason for addressing you was simply a desire to testify, that though "Scalpel" may not see, or rather not choose to see (for of his perfect sincerity I have my doubts) the force of them, there are others who do, and are obliged to you for them. The sooner the paths of science are freed from such will-o'-the wisps the better.

I am, Sir, your constant reader,

PROBE.

April 2, 1843.

PILBROW'S DISCOVERY IN STEAM-POWER.*

Sir,—I can but congratulate myself that the *principle* of my discovery has been so readily and cleverly generalized by "Scalpel" by illustrations independent of my own; and I beg to express my obligations to an individual who has, unknown to me, written so conclusively and eloquently in my support. If I mistake not, "Scalpel" must have been one of those scientific persons who have, with Professor Moseley, Mr. Lloyd (for the Admiralty,) and many others distinguished for their scientific attainments, witnessed at different times my experiments in verification of my discovery. But be this as it may, it is exceedingly gratifying to me to find an original mind capable of appreciating it, and bold enough, thus early, publicly to express his opinion.

As I should be sorry to be considered the discoverer of an absurdity, I hope you will do me the justice to correct your singular misapprehension of my discovery. "Mr. Pilbrow," you say, in your note to "Scalpel's" letter, page 269, "asserts that there is a power, '*in mere velocity alone*,' *exclusive of*, and *supplementary to*, *the boiler power* by WHICH IT IS PRODUCED!!" My specification does not say so; "Scalpel," therefore, might well "evade" what he cannot find. You have at page 240 correctly extracted what I *do* say, which is, that "I have ascertained the PROPER EFFECT or FORCE DUE TO THE EXPANSIVE VELOCITY of steam; namely, that both the whole available power and extreme duty from expansion may be obtained from the simple expansive velocity of steam, WHEN applied in the peculiar manner hereinafter described." All my subsequent explanations are but in elucidation of this, the *very first description* in my specification of what my invention consists in. This is the germ of my discovery, namely, "the PROPER effect or force due to the expansive velocity of steam," WHEN that velocity is "applied in my peculiar manner."

The "proper" or *real* force which steam is now found to possess in its expansive velocity has never before been known; and my discovery simply proves that it possesses, "when properly applied," more than double the effect to what it does when used as in Hero's engine, or against flat vanes, as in Branca's, and consequently a much greater impulsive force than any one supposed. I neither add any thing to the *cause*, nor say as you make me, as before complained of. Neither have I said, as you further make me say at page 269, that "a double power is derived from the mere velocity alone." Such is not *my* "theory." "A double power or effect is derived (solely) from" using a cavity instead of using a flat plate. *That is my "theory,"* as you will see in your extracts at page 241, when you confined yourself to adopting my own language in my specification.

Those who are acquainted with the elementary laws of physics well know that "concentration of the current of steam in the pipe" cannot, by any possible means, give one ounce more pressure in any part of the pipe than in the boiler. Nor is it the fact, as assumed in your note page 269, that "the extra pressure is indicated at the point of the nozzle." "The double effect" is found only when the steam has actually escaped *from* the nozzle, and is about ¾ inch *out of* or from it. The steam has then had time to obtain "its expansive velocity," and when arrested by a cavity gives out "double the effect" to what it gives on a flat plate.

The subject is a wide but interesting one, and would lead to many long papers, which is perhaps unnecessary, particularly as you seem to think that if I can prove it *not* to be "*concentration*" of steam in a pipe which gives this great effect, you will be satisfied; if so, then I will only trouble you and myself further to assure you that you are very much mistaken; for all kinds of experiments have been tried to satisfy myself as well as others. Experiments were tried with orifices of *different* areas, and each gave its ratio of effect *exactly in proportion to the area*—(not, as you suppose, a lesser one giving more, but LESS, and in EXACT PROPORTION.) Again; the pipe of supply to the nozzle is required large,—not, as you think, to "concentrate" the steam, but to supply the nozzle with steam as dense as

* This letter from Mr. Pilbrow himself, came to hand after the receipt of the two preceding communications, and after the remarks on that of "Scalpel," were in type.—ED. M. M.

that in the boiler (*when* the pipe is *long*)—for, in a series of experiments (much too long to mention) it was found, that if the pipe were but *little larger* than the orifice, the steam became attenuated before it reached the nozzle; and by guages placed near the nozzle, a pressure was indicated *far* below that in the boiler. Now, the object is, to keep the pressure near the orifice as high as it is in the boiler; because, although we get always more than double the amount of pressure, *three-quarters of an inch from the orifice* (outside), *than that within*, yet, unless the steam within be kept in equilibrium with the boiler, we should, in common with any other engine, lose, in *appearance*, the amount of pressure.* But when a long pipe is unnecessary, and we place our orifice on the boiler itself, we then get *at once* more than double the pressure in our cavity than that in the boiler. Therefore, Mr. Editor, you are perfectly mistaken, you perceive; and that the whole hangs upon *velocity* of the steam's expansion (of course as a secondary cause), is proved by the experiments of letting the steam issue through *holes* merely cut in the metal, and through tubes: the tubes permitting more to flow, gave the highest indication of pressure,—the expenditure being in proportion.

Presuming the foregoing will satisfy you, my time being so fully occupied, I will only add, that your science of Mechanics, as it relates to power, &c., seems to require a word.—*Pressure* must not be mistaken for *power*, nor *power* for *pressure;*—there may be pressure without power being elicited—(which is *truly*, in mechanics, without power)—but never power without pressure. Now, what makes pressure become power, is action, or velocity, or motion. There is none, let the pressure be what it may, until *action* commences; and action, there can be none without pressure, or force somewhere. Power, therefore, is pressure combined with action, or *velocity*. Velocity is the effect always of pressure, and has in it the *whole* amount of that pressure; therefore, velocity *is* power, and may be the *cause* of power (though pressure first caused that velocity.) Now, steam in a high-pressure boiler while closed, has a pressure, perhaps, of 100lbs. per square inch over a surface of many thousand square inches, yet no one would think of saying there is any *power given* here. This is but simple pressure; but when any part is allowed to *move* before this pressure, immediately we get power (instance the piston of the steam engine). Now, what I say is simply this, that this steam has, by chemical means, &c., become gradually packed into a dense state (high *pressure*), and being an expansive fluid, it will, when released, expand its volume *rapidly* into a much larger one; and the *velocity* with which it will do this, as well as the *extent*, are dependent upon the state of density. I have found, then, that its *effect in striking* a cavity is dependent upon the *velocity* of its issue; which velocity of issue is wholly dependent upon its density, of course. I then found out its ratio and laws, and by very delicate and numerous experiments, occupying more than twelve months (which will be published shortly), I found the effect to be obtained by the pressure (the pressure at a given velocity) multiplied by the velocity (which pressure was wholly *dependent* upon the *amount* of *velocity*) would give a duty or effect equal exactly to the amount of power or duty which would have been required to have pumped into a vessel the same quantity of gas to the same density; or, which is the same thing, as much duty as a piston in a cylinder would give out worked under the *very best circumstances* of *expansion*, taking the increments of expansion to atmospheric or vapour points.

I may finally add, that the fact of the discovery has already become established, and is admitted among the true additions to science by sufficiently competent individuals, to render it immutable. The practical application of this new force is, however, a distinct question, which I am prepared to discuss when properly investigated; until which time I shall respectfully decline further discussion, and am,

Your obedient servant,

JAMES PILBROW.

Upper Clapton, April 3rd, 1843.

[Mr. Pilbrow has a right to change his views and opinions as often as he pleases, as long as he does so at *the expense of his own character for correctness;* but we cannot allow him to do so *at ours*. He is now pleased to deny most positively that he ever asserted that he gained his "double power" from mere velocity alone. The "double power or effect," he says, "is derived *solely* from using a cavity instead of using a flat plate," and "*that is my theory.*" It may be Mr. Pilbrow's "theory" now, but that it was not his theory when he penned his specification is clear from the following extracts, as well as from the entire scope of the document. "I became acquainted," he

* The same thing takes place in the common engine, if the pipes which supply the cylinder be contracted or too small; the piston then does not receive the same pressure per square inch, as the boiler does.

says, "with this *new* and singular property of steam that it possessed IN ITS MERE VELOCITY ALONE a propulsive force from its lineal expansibility equal in power and duty to the gross effect obtained when cut off and allowed to expand, under the best circumstances." Again, "The cavity not only received the same amount of impingement as the flat plate received, but by this peculiar injet and reaction, or reissue of the steam, ITS WHOLE VELOCITY WAS ARRESTED, AND THE CAVITY THUS ACQUIRED ANOTHER POWER OF EQUAL AMOUNT," &c. Further on, "When I had discovered how this DOUBLE POWER was to be obtained by ARRESTING AND TRANSFERRING THE WHOLE VELOCITY of the steam," &c. In another part he states that "the fact of a power being got from the EXPANSIVE VELOCITY of steam when properly arrested of MORE THAN DOUBLE what would seem, *prima facie*, to belong to it, as indicated by the pressure in the boiler, is consistent with the additional force required by other bodies," &c.; and he proceeds to illustrate this by the case of falling bodies, which, if the use of cavities instead of flat plates had been all his "theory," would have had no more to do with the business than with the roasting of cockles. And he winds up by telling us that "the law is, that all motion is power—power IN PROPORTION TO THE VELOCITY OF MOTION," &c. It is clear, therefore, whatever "Scalpel" may insinuate, or Mr. Pilbrow assert, that our statement of the theory, as laid down in the specification, was perfectly correct; and more than probable that, but for our complete demolition of that theory, no such denial or disavowal of it would ever have appeared. If we are now to understand Mr. Pilbrow as meaning merely that he can obtain double the power or effect "by using a cavity instead of a flat plate," then all we have to say is, that the "great discovery," so loudly trumpeted by "Scalpel," and regarded with such ostentatious self-congratulation by himself, has dwindled down, at last, to a wonderfully small affair. Catching double the steam in a cavity that he can do by means of a flat plate, is not doubling the amount of the steam itself, or increasing in the least its elastic force, or obviating, except in a very slight degree, if at all, the insuperable objections which exist to all modes of applying steam by impact instead of by pressure.—ED. M. M.]

THE FLYING SCHEME.

Sir,—The aerial scheme being now the lion of the day, I beg to be allowed to make a few remarks in the *Mechanics' Magazine* upon its probable result.

Although the "roaring" is extremely loud, and the public expectations are extremely "flighty," I fully expect better wings and other concomitants will be required, than ingenuity in the human being can invent, before any machine can vie with the eagle. The present aerial schemer is deserving of much praise for his perseverance; but the public look also to utility, and in this scheme they will not find any. The circumstance of an inclined plane being required for starting renders it useless in every other country; besides which, I am sure no precise spot can be reached, which must at all times render descending dangerous. Supposing the machine can be suspended for any length of time, it would be liable to be driven far distant from the "wished-for spot," where probably the only inclined planes would be either fearful rocks or icebergs. A vessel at sea, with a powerful purchase on the water, too frequently refuses to answer to the helm, and is driven often to destruction. But an aerial machine has no such purchase or stability; and in cases of sudden storms there are no harbours for its refuge. An accident occurring to a railway train may doom a dozen passengers to destruction out of 500; but with an aerial machine, all must inevitably be lost. A storm would drive it in any direction, and the steam apparatus, if at work, would only accelerate such speed to its total ruin; for having no immoveable surface or body to move over, by which adhesion, traction, or purchase is gained, I think it will be impossible to guide it under any, and certainly under every circumstance. In the next place, there would be a vast liability to accident in such machine, from a derangement of its parts of suspension, from electric fluid, or from the steam apparatus; none of which contingencies can be prevented to a certainty; and who would be left to "tell the tale of horror?" The bird that is formed in the most perfect manner for flight, is frequently driven from its course. Its powers of suspension are wonderful. The bird has two muscular pinions, a small head, a body capable of inflation, and is covered

with feathers, the substance of which is extremely light, and the part inserted in the body is enlarged, hollow, and air-tight. The muscular pinions have an arrangement of feathers peculiarly adapted for sailing in the air; they have the power of rapidly expanding or contracting, perpendicularly or horizontally to any angle. The tail is used horizontally for rising or descending in the air. None of these necessary, but wonderful perfections are liable to disarrangement in use; for all the ball and socket, and other joints are naturally lubricated and preserved in order. If, therefore, all these fine arrangements, together with the additional buoyant power necessary for the transport of weight beyond that of the machine cannot be fully contrived, the speculation is useless and dangerous, and the loss to many great.

G. L. SMARTT.

Enfield, April 4, 1843.

MECHANICAL FLYING.

Sir,—I think it proper, in justice to my family, to myself, and to the right understanding of important matters, to trouble you with a few lines on the subject of the proposed *mechanical* flying machine. You cannot, Sir, forget that it was in the year 1824 that I communicated, confidentially, to you, my plan of *mechanical* flying. I shall, as soon as I can get the means, publish a printed sheet or two, expository of the entire subject. Meanwhile, I hope you will not delay the insertion of this letter, which is abstracted from one addressed to you on the 9th of November, 1842, but which you rejected, and returned to me. I wrote as follows:—"I have heard that a number of noblemen and gentlemen are forming a company to navigate the air by *purely mechanical* means. I rejoice to hear this, although it must naturally be mortifying to me, personally. *I* conceived the only possible means of accomplishing this object in 1824, and thus, nineteen years ago, I announced my discovery in the *Mechanics' Magazine*, *The Times*, *Morning Chronicle*, and other periodicals. Of course I did not indicate the mechanism by which this grand object is to be obtained, as I had not the pecuniary means of securing it by patents. On the subject of our tea-garden balloons, I have often written in the *Mech. Mag.* See particularly No. 684 and 685.

It is true, that in our atmosphere there are often various currents of air flowing in contrary directions; but we must soon exhaust our gas and sand ballast in the repeated operations of ascending and descending, to get into these currents. A well constructed balloon, *à la Montgolfier*, may ascend and descend, *ad libitum*, by the increase or decrease of the fire; but no party has been found to give it a proper, full trial. I have attempted to find some such, in vain. I thought, that as most men of money are ignorant and prejudiced, I might find some supporter in a Montgolfier *balloon*, even from those who laughed me to scorn for my proposal to fly without balloon, by mere mechanical means. But I have now to speak of mechanical flying, either by manual labour, or by steam.

In my forthcoming pamphlet, (if I can get for it an *accoucheur*,) I shall give, *verbatim*, my advertisements in the newspapers of 1824, 1825, 1826—and also the *real* principles upon which mechanical flying is to be accomplished. In 1824, the highly talented Mr. Goldsworthy Gurney lent me the use of one of his workshops in Albany-street, Regent's Park, in which I worked most assiduously, during six months, at the discovery of, and the proper construction of the various parts of my machinery. I succeeded to my utmost satisfaction, both in theory and practice. I then wrote to several wealthy noblemen and gentlemen, and some I spoke to —amongst others, Mr. J. Morrison, M.P. They all laughed at me. I also advertised in the papers, on the same principle upon which I had made personal appeals, thus:—"Any nobleman or gentleman of ordinary discernment, and having a small sum of money to spare, may secure the immediate execution of an invention, than which none so important has been achieved during the last four thousand years. This is to bestow on our human species as full dominion over the air, as they now have over the land and waters. Any person who will advance two thousand pounds, for the purpose of taking out the indispensable patents, taking suitable premises, and enabling the inventor to devote his time to the work, shall have one third share of the incalculable pecuniary and other advantages which must accrue to those who originate an invention which will cause an immense alteration in the physical and moral condition of mankind. * * * It is not expected that any one should 'buy a pig in a poke;' so that if, after careful inspection of the means I propose and have constructed, and mature deliberation, the man of money shall be completely satisfied, he shall pay down the money. If he be *not* convinced, then he may button up his pocket, and only give me his word of honour not to communicate my plans, or use them in any way whatever." Thus, all the risk was on *my* side. But I might as well have preached to "the deaf adder" of the Psalmist! I was laughed at; as I also was, in 1816, for my bituminous

paths; in 1824, for wood paving; in 1827, for the screw propeller, now called the Archimedean: as Windsor was for his gas "smoke lights;" Fulton, for his sea-going steam-ships; Köenig for his steam printing-machine, &c. &c. &c.

Several of the editorial gentlemen who have written their remarks on this published mechanical flying-machine are mistaken, in saying that the plan has been tried over and over again, and failed. This, I beg leave to say, is a great mistake on a very great subject. Leaving alone Icarus and his waxen wings; a Portuguese monk; an Italian mountebank, who broke his neck, &c., I will jump to two real philosophers. Our English Doctor Hook, who was secretary to Sir Robert Boyle—who was the inventor of the air-pump, the perfecter of the thermometer and the barometer—who made the first pocket spring watch, which is now preserved at Oxford, with catgut in lieu of a chain—this Dr. Hook spent 20 years of his valuable life in attempting to fly. But he, like all the other attempters, took nature *too* closely for his guide. He attempted to fly with wings attached to the arms. Now, man has not the necessary power to support himself—much less to progress by any such means. The muscles which move the wings of a pigeon, for instance, are seven times the weight of all the other muscles of its body put together; whereas the muscles which are applied to the movements of a man's arms, are only one-seventh of his other muscles. So, according to Cocker, 7 × 7 being 49, a pigeon must have forty-nine times the power in its wing that a man has in his arms. The like error was fatal to Bishop Wilkins, who wrote a Latin treatise on human flying in the air. He possessed pecuniary means, and would have succeeded, but, like his predecessor, Dr. Hook, he also got on the wrong scent, and thought of wings! Bishop Wilkins felt so confident of the faculty of flying in the air being one day and soon achieved by mankind, that, in his work on flying, he says that "it will be as common for a man, going a journey, to call for his wings, as he now calls for his boots."

In the little pamphlet which I intend to publish, if I can, I shall develope all the main views and theorems on this important subject. But a few more words are absolutely called for in this brief, hasty scrawl.

The men who ridicule the idea of flying in the air, all assume the ridiculous idea of our flying with "wings like unto a dove." If these folks had endeavoured to *imitate nature* by imitating a fish, in getting from London to New York, by jumping into the water and wagging their tails like unto a fish, I *guess* they would have been some time in performing their visit to Jonathan! If they had attempted to transport loads on a cart supported and propelled along the roads according to the mode of nature, by reciprocating legs and feet like those of horses, oxen, &c., I *guess*, also, that they would have found it a difficult thing to set and keep it in motion, and a horribly bumping concern! But man invented the wheel, which has no prototype in nature, but upon which all machines, from a watch to steam-engines, weaving-frames, wheel-barrows — all — all have their existence! It has been much mooted that birds are of less specific gravity than men. Pray, gentlemen, what is the specific gravity of a bat? Has he any of your talked-of valves to his wings? But as *wings* are not to the purpose, I need not dwell on such points. So I will conclude by stating, that *I* have, during a long period of labour, discovered the true method of constructing all the various shafts, &c., far stronger and lighter than any substances produced by nature. I have also a wheel-propeller, of five times the power of any vane-screw propeller analogous to the "Archimedean," which I presented to the Lord High Admiral, in 1827, and was rejected! I have a *boiler of absolute* safety, which, when only 1 foot cube, is a 2 horses power. One of 4 feet is a 40 horses power. I made what I call a *Floatage*, 22ft. by 18ft., to carry one person, and to be propelled by a *manual* pull of 20lbs., but only at intervals, for *constant* labour will not be required in a machine *properly* constructed.

Experienced as I am in this matter of aerial navigation, I venture to predict that the thing just engraved and exhibited will not perform the part expected from it.

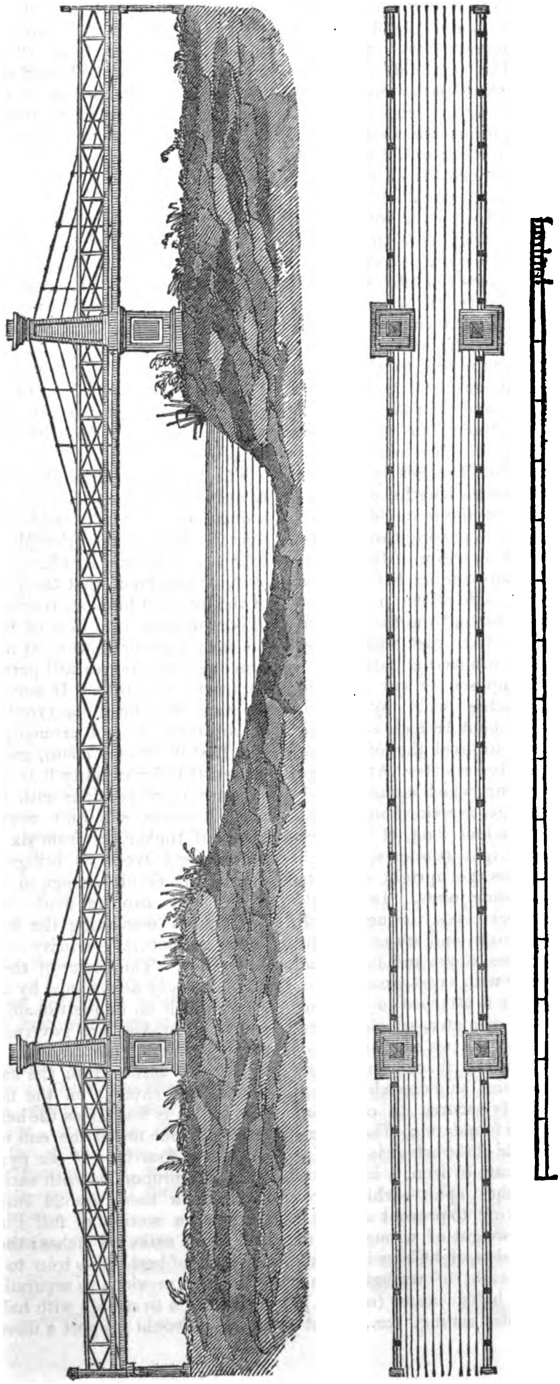
I am, Sir, your obedient servant,
F. Macerone.

Adelaide-street,
St. Martin's, Strand, (Cunningham's.)

DESCRIPTION OF THE TIVERTON SUSPENSION-BRIDGE—DESIGNED BY, AND ERECTED UNDER THE SUPERINTENDENCE OF, MR. THOMAS MOTLEY, CIVIL ENGINEER, BRISTOL.

(Communicated by the Author.)

The bridge, represented in the accompanying engraving was erected in 1837, over the river Avon, at Tiverton, near Bath, and is the first of the kind ever constructed. The span of the middle compartment is 120 feet, from centre to centre of the pyramids; the land ends are about 55 feet each, making the whole length of the bridge 230 feet. The road-way is 14 feet wide between the suspending bars. The four pyramids are placed



each pair on a concrete foundation, 12 feet by 22, 16 feet deep on one side, and 9 on the other side; the concrete rests on a firm stratum of clay. The pyramids are each composed of six courses of Bath stone, 2 feet 6 inches deep, containing two blocks in each course. Their dimensions are, base, 5 feet 6 inches, by 4 feet 6 inches; top, 3 feet by 2 feet 6 inches. They are covered with a capping, as shown in the engraving. At the base of each pyramid, level with the lower part of the beam of the bridge, is a large cast-iron-bed, secured by holding-down bolts, inserted into other cast-iron plates in the foundation. In the centre of the large plate is inserted an iron bar, 3 inches by 1 inch, which passes up the centre of the pyramid to a cast-iron plate at the top, to which it is firmly secured. The suspending bars are 2 feet 6 inches apart, and the space between their points of attachment to the bridge, about 9 feet 3 inches. The substance of these bars averages full 2 inches by 1 inch; they are welded in entire lengths, and connected on each side of the pyramid by two bars 3 inches by ½-inch, passing through the pyramid, bent in the direction of the strain, and fastened to the suspending bars by gibs and keys. On each side of the pyramid is inserted a cast-iron plate, from the base to the top suspending bar, cast with holes, through which these connecting bars pass.

The beam is composed of two bars of wrought-iron, 7 inches wide by ⅝-inch thick, in lengths of about 18 feet, each properly arranged so as to break the joints, and they are connected by brace plates. At the edge of each suspending bar, which connects with the beam of the bridge, is welded an upright piece of iron, about a foot long, of the same substance as the upright supports, 1 ⅝ inch by 1 inch, and to this the upright supports are attached by coupling joints. In the uprights are made proper eyes, through which the suspending bars pass, and are made tight by a wedge in the eyes above and below the bar, and covered over with a cast-iron rosette. Each suspending bar is attached to a round iron bolt, 2 inches diameter, which passes transversely to connect the two ribs, or beams. At the land abutment the rib, or beam, is secured to cast-iron chairs, held down by strong iron bolts, and firmly secured to cast-iron plates, inserted in the foundation. The diagonal railing on each side of the bridge is filled in with upright round bars of iron, 1 inch diameter, about 6 inches apart—which are omitted in the engraving, to prevent a confusion of lines. The weight of wrought-iron in the suspending and upright bars is about 7 tons; the whole weight of wrought-iron, including transverse bolts, beams (or ribs,) foundation plate bolts, railing, &c., about 18 tons; and of cast-iron, about 5 tons. The floor is composed of Memel joists and oak platform. The joists are 12 inches deep by 3½ inches thick, bevelled off on the top from the centre to 10 inches at the ends; the flooring boards are about 9 inches wide and 2½ inches thick, and are covered with a thick coating of coal-tar and sand, on which is laid screened gravel, of an average thickness, in a convex form, to allow the water to run to the sides of the bridge.

The following was the mode of construction adopted:—The land ends of the bridge were first erected; the middle portion, over the towing-path and river, was constructed by means of a platform, or hanging scaffold, suspended horizontally, by means of ropes and pulleys, from the top of the pyramid. This platform was chained to the iron work, as it extended out, so that the bridge was carried over the river without any support from beneath.

The foregoing description will, it is presumed, be sufficient to enable those who are acquainted practically with iron to form a tolerable idea of the principles on which the bridge is built, and its effect. It may, however, be observed, that the principle is that of the inverted bracket, converting the force of compression into that of tension, and at the same time preserving as much compression as circumstances will permit, or as may be deemed requisite. It must be evident to the most superficial observer that this mode of construction and arrangement must be less flexible than a chain, and practice has proved that for stability it is unquestionably superior to suspensions with curved chains, and, therefore, will rank next to cast-iron. Loads of timber, of from six to eight tons, have passed over this bridge without producing any visible change in the floor; indeed, none can be made without either breaking or elongating the bars, except so far as the natural elasticity of wrought-iron will allow. The power of the above bridge may be nearly ascertained by treating it as a lever, which is, unquestionably, the law by which all bridges are governed. Thus the first suspending bar descends to the bridge at 2 feet 6 inches from the base of the pyramid, and extends on the floor nearly 10 feet, which is four times the height, and consequently one ton at the end would produce a strain of four tons at the pyramid, and so on in like proportion with each of the upper bars. Now there are 24 suspending bars, averaging a section of full 2 inches to each bar, which make 48 inches; then, supposing one inch of best cable iron to bear a strain of 20 tons previous to separating (though it would begin to stretch with half that strain,) 48 inches would support a direct or perpen-

dicular strain of 960 tons; but the average being 4 to 1, they would only support a uniform load of 240 tons, the weight of the materials included. Thus, if the proportion of the material were increased, say 50 per cent., it is presumed that this kind of bridge would be well adapted for railway purposes, even with such ponderous engines as are used on the Great Western Railway.

The cost of the above bridge, including the expense of masonry and very deep foundations, exclusive of embankments and approaches, was under 2500*l.*, and was erected within 5 per cent. of the estimate. Provided only that it be duly painted, it is presumed that the iron-work will endure even for centuries without requiring repairs of any consequence, as may be fairly expected, from its inflexible nature, and the almost entire absence of friction. It may be further observed that the joists, which are about 21 inches apart, the ends projecting 9 inches, are notched about 2 inches down on the double iron beam, to which projection they are securely fixed by iron bolts with cross heads, so as to clip the lower edge of the beam, thus performing the office of cramps; and the boards being well laid, longitudinally, produce all the effects of horizontal diagonal bracing, and, therefore, no diagonal bracing is used, and hence the absence of an oscillating motion.

(COPY.)

Newark Iron Works, Bath, March 22.

Dear Sir,—In reply to your request as to my opinion of the present state of the Tiverton-bridge, which I assisted in the erection of, about six years ago, I beg to state (with the exception of an immaterial effect, produced by a slight sinking of the masonry on one side,) it is as perfect and sound as when first erected, and, I have no doubt, will continue to be so for very many years, without requiring any repair, except occasionally painting. As regards my opinion, generally, of the principle of construction, I have no hesitation in stating that, under general circumstances, it is equally strong as the best proportioned suspension-bridge with curved chains, *and vastly superior to them in stiffness, and the absence of all undulation, every part being supported by direct tension.* It has also this great advantage, that the giving way, or removing any one of the tension-bars, would not endanger the rest—any one of them being removable at pleasure.

I remain, yours truly,

GEORGE RAYNO.

Mr. Motley.

IMPROVEMENT IN THE MODE OF USING DANIELL'S OXYHYDROGEN JET.

Sir,—Amateurs are greatly hindered from employing the powerful oxyhydrogen blowpipe, through fear of the dangerous explosions, from which bad quality the instrument, in its usual form, is not altogether free. However, the compound jet, contrived by Professor Daniell, has not this objection, but it is not quite so powerful and economical as the variety used for the "mixed" gases. In the compound jet above alluded to, instead of making the oxygen and hydrogen gases pass separately through their respective tubes, as is usually done, I unite the *hydrogen* with oxygen, and the *oxygen* with hydrogen, in such measures, that neither of the mixtures are capable of being exploded. This ensures a much more perfect admixture of the gases than heretofore, and renders the instrument nearly co-effective with those used for burning the "mixed" gases in atomic proportion.

I am, Sir, your reader and well-wisher,

M. Z. ROCKLINE.

Newcastle-on-Tyne,
March 27.

WALKER'S WATER ELEVATOR.

Sir,—In reply to the remarks of Mr. Wright (ante page 251) I beg leave to assure him that I have not forgotten, nor do I mean to shrink from fulfilling, the promise I made some time back to report the progress of Mr. Walker's important invention, the *Water Elevator.*

I expect very shortly to be in a position to show that Mr. Walker's progress has been highly satisfactory; but the fact is, that so important an improvement has been made upon the original discovery as to require a second Patent for its protection, which has only recently passed the Great Seal. As any description of these improvements, however, must necessarily at present for the most part consist of "statements" to which your readers "could scarcely give credence," I wish to postpone my promised communication until some extensive applications of these improvements, now in contemplation, have furnished (as I doubt not they will) the most unequivocal proofs of the great superiority of this method over all others for raising water in large quantities.

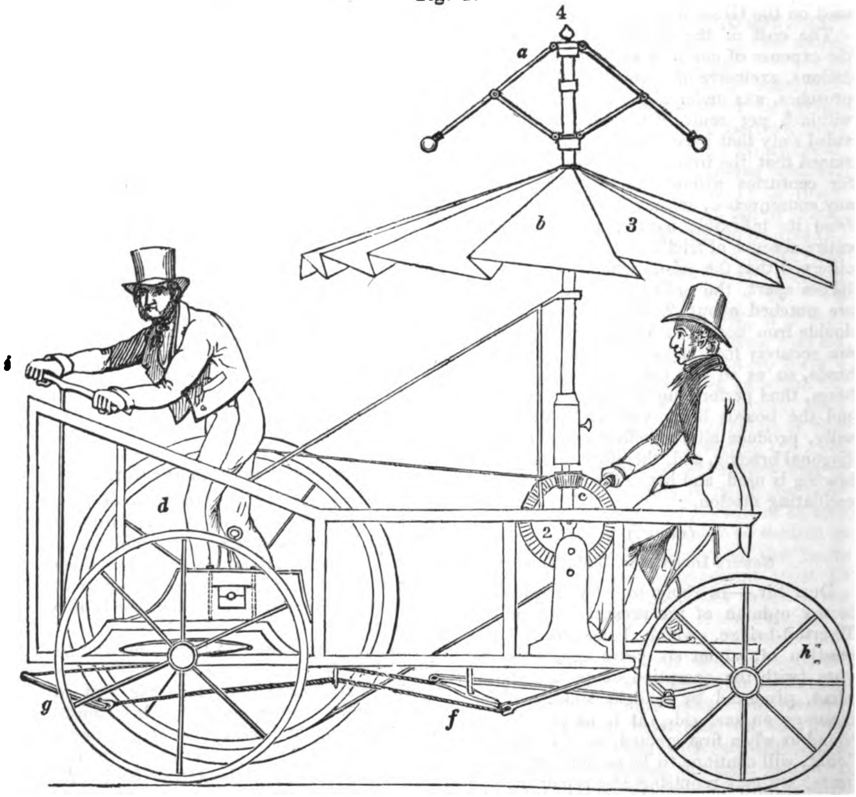
I am, Sir,
Yours respectfully,
WILLIAM BADDELEY.

29, Alfred-street, Islington,
March 29, 1843.

DESCRIPTION OF MR. WILLIAMS'S PASSENGER-PROPELLED LOCOMOTIVE CARRIAGE—BY THE INVENTOR.

[The carriage, of which we have now the pleasure of publishing a description, is that mentioned in our 36th volume, page 413, as having been invented by Mr. P. Williams, of Holywell, Flintshire, surgeon, and as having been the subject of a number of very successful trials at that place. By 60 revolutions only per minute a rate of speed was attained of upwards of 10 miles per hour. The parties for whose use the ingenious inventor thinks it more particularly applicable are young people and invalids.—Ed. M. M.

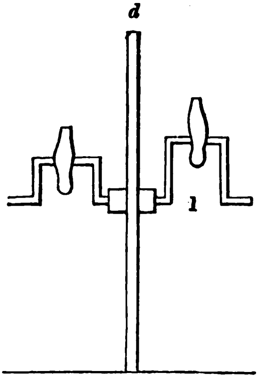
Fig. 1.



The machine consists of a combination of four principal parts—1. A Crank; 2. Chain Pulleys; 3. A Pneumatic Wheel; and, 4. A Governor Fly.

1. *Of the Crank.*—The crank-wheel *d* is 3 ft. 6 in. diameter, and straight, on the right side of the fellies of which is placed the pulley-groove, a small distance below the tyre, on which the endless chain works, connected with the small pulley at *c*. The cranks are 6 inches deep and 8 inches wide, situated at each side of the wheel, close to the nave, and fixed, with respect to each other, at about half-a-quarter, or one-eighth short of right angles. A pair of clogs are placed on each crank, with sheet-iron soles, to which are riveted two journals, standing apart from each other at the width of the sole, swivelling on the crank, and made moveable by clams secured by nuts. The slippers or clogs may be secured to the feet by buckled straps across the insteps, if required: but this is not necessary or desirable, as the cranks are always in a position to act. The crank-axle rests at each end upon a pair of steps, secured by a pair of screw pins passing through each end of the flange of the steps and the iron stays, which are fastened on the frame of

Fig. 2.



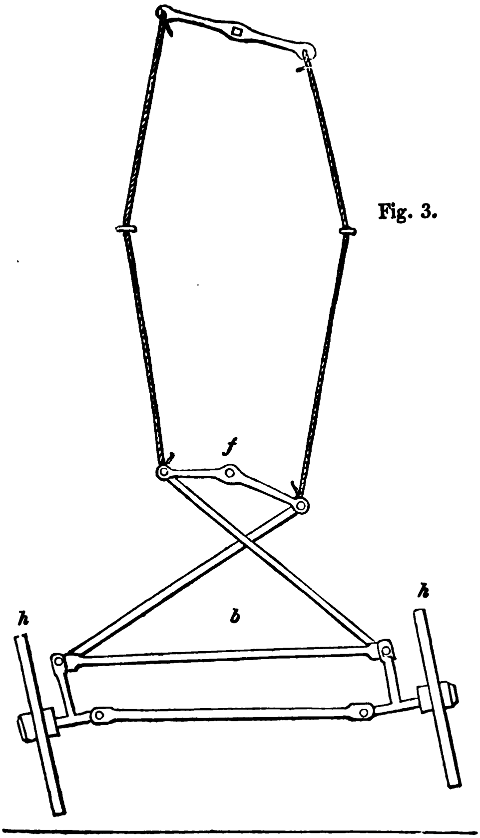


Fig. 3.

the carriage, and nutted underneath. An upper iron plate, of about the length and breadth of the step with its flanges, is pinned and screwed to the latter, through which plate passes a pin riveted loosely on the inside of it, and between it and the flanges of the step, and passing through the centre of the iron stay before mentioned, in a screw socket with a square head, and resting with a shoulder on the upper side of the stay, on which is fixed a moveable handle, for the purpose of turning the screw-pin, so as to lift the crank-wheel from the ground for safety in descending hills, or suspending the motion of the machinery for the purpose of applying a pony to the carriage, if required. The wheel may also be locked by a strong strap passing round the rim of the wheel, and secured by a button on the frame. A second, or under plate, similar to the upper, is fixed below, but loosely, through which pass the flange and step pins, for the purpose of keeping the step steady, and from moving sideways.

2. *Of the Chain Pulleys.*—The small pulley is about 10 or 12 inches diameter, turning on a frame firmly fixed in the frame and floor of the carriage, at a suitable height for the convenience of turning the winch-handle.

3. *Of the Pneumatic Wheel,* (*or Revolving Umbrella.*)—The pole is about 5 to 6 feet long, and about 2 inches thick, composed of lance-wood ribs, $\frac{1}{2}$-inch square and 2 feet 6 inches long, placed in the usual form of an umbrella, eight in number, with an additional number of eight of the same length, but of somewhat lighter texture, placed immediately above the others, and connected to them at the circumference by means of tin straps of 6 inches long, but gradually

shortening until united at the pole end in a point. The stretchers are about 13 inches long, made of the best iron, three-eighths of an inch square, connected with and acting upon the lower and stronger ribs. The covering may be of canvas or oil-cloth, such as is used for table-covers. The manner in which the cover is applied is from the one lower rib to the next upper one, and so on around, thus forming a sort of fin, at an angle with the lower one of about three inches out of the vertical line at the circumference, tapering to nothing at the pole. The front of the fin is also covered with the same material. It will thus be observed, that the wind will always pass over the longer and flatter angle of the back of the fin, and strike on the shorter, or more vertical one of the front, so that the wheel will always revolve in the same direction, whatever be the point of the wind. The length of the larger angle, or the distance between each lower and upper rib at the circumference, is about 1 ft. 9 in. At the lower extremity of the pole is placed a small bevelled pinion wheel, working in another larger one fixed on the axle of the little pulley, and close up to it, turning on its pivot in a step fixed on the bearing of the pulley's axle. The pole is supported by a side stay from the frame of the carriage, connected by a ring or journal around the sliding-box of the stretchers, which, with the pole, turns freely round in it. The sliding-box is secured at its full stretch by a thumb screw-pin passing through it and the pole. It will be obvious, from this explanation, that the pneumatic wheel can with ease and speed be made to collapse in an instant, by a few unscrewing turns of the thumb-screw.

4. *The Governor Fly.*—This substitute for the fly-wheel is so apparent, that little need be said respecting it, further than that the length of both levers is about 2 feet, made of thin iron, say half-inch square, with a weight of about 3 lbs. of lead appended at each extremity, and riveted through, and upon the principle of the umbrella, expanding by the centrifugal force of velocity, and collapsing when at rest.

The Guiding-wheels.

Diameter, 22 inches; the axle jointed at each end, say from 5 to 7 inches from the centre of the bush of the wheel, which is done to accommodate the turning of the wheels in *less compass*, so that they do not pass *under* the carriage, and expose it to the liability of upsetting, by being thrown (as it may be termed) on its *three* legs. The stays are firmly riveted or welded into the *short* arm of the axle, between the joint and the nave, having open jaws at the other end to admit the end of the connecting-bar, and both bolted through by pin and nut, so as to form a joint. A sort of washer is placed under the head of the pin or bolt, at each end of the connecting-bar, through which the latter passes, and having a small shank with an eye at the end of it, for attaching a spring hook, link, or swivel, to the latter of which is again attached a screw swivel, to shorten or lengthen the connexion, as it may require. Strong wire rods are fixed in these, crossing each other from both ends, as seen at *b* in fig. 2, and attached to the cross lever *f*, fixed on the centre connecting spindle, from the latter of which *cords* are continued in *straight* lines to the guiding-lever, at the front or leading end of the carriage, fastened to the cross lever fixed in the former by screw and nut, and swivelling with it underneath the frame of the carriage; thus forming the whole of the guiding apparatus at once visible to common observation, and bringing the carriage under easy and perfect control. An elliptic spring is bolted to the *centre* and *fixed* piece of the axle and the cross-bar of the frame above, to give an easy motion to the carriage, and to answer to the effect of the hind *carrying* wheels, which are attached to elliptic springs, a pair to each wheel, riveted or bolted with pins and nuts to plates fixed on each end of the axle and each side of the wheel, and to the frame. The advantage of these springs is to enable the wheels to accommodate themselves to any uneven surface. The engravings show how the carriage is worked, and the direction it travels.

The frame is about 7 or 8 feet long, and its construction easily understood by the elevation fig. 1.

In fig. 1, *a* 4, represent the extended arms of the governor fly; *b* 3 show the *flat* and oblique angles of the pneumatic wheel; *c*, the chain pulley; *d*, the crank-wheel, which is shown detached in fig. 3; *f*, the connexion of the guiding apparatus; *g* shows how the

cords are brought to the guiding-lever at the point *i*; *h*, the guiding-wheels, situated behind, instead of the fore part of the carriage.

THE COPENHAGEN COMMON ROAD STEAMER.

Sir,—I have been somewhat startled by a notice at page 272 of your Number of to-day, extracted from the *Mining Journal*, to the effect that some steam carriage "upon a system newly invented by a certain lock-smith and very ingenious mechanician," ascends with ease hills of 30 degrees inclination, by the aid of engines of 8 or 9-horse power; the said carriage, moreover, carrying 30 passengers and merchandize, and therefore, weighing with the engine, at least five tons. It is worth while enquiring with what *velocity* these hills would be ascended by this wonderful carriage?

It is well known, that if H = the horse power employed, R = the resistance overcome in pounds, and v = the velocity in feet per minute, then $H = \frac{Rv}{33 \cdot 000}$; or $v = \frac{33 \cdot 000\ H}{R}$.

It is also well known, that a weight, W, rolling, or tending to roll down a plane, inclined to the horizon at an angle θ, exercises from its gravity, a resistance = W sin. θ, in the direction of the plane. Then the friction upon a common road may be safely estimated at ·035 W; wherefore, since the resistance to be overcome is composed of gravity and friction (the resistance of the air may be neglected at the speed we shall presently obtain,) R = W (sin. θ + ·035); therefore, $v = \frac{33 \cdot 000\ H}{W\ (\sin.\ \theta + \cdot 035)}$.

Taking H = 9, W = 5 tons, and $\theta = 30°$, we find v = 50 feet per minute nearly, or equal to about *half a mile an hour!* If the locksmith can make his carriage run up these hills faster, he will be a very "ingenious mechanician" indeed.

I am, Sir, yours, &c.

DIDYMUS.

April 1, 1843.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN GEORGE HUGHES, OF 158, STRAND, GENERAL AGENT, *for a new application of telegraphic signals, and the mode of applying the same.* Patent dated June 9, 1842; Specification enrolled December 9, 1842.

The "new application" for which this patent has been taken out is, the transmission of orders from one part of a dwelling-house, or other building, to another, or one part of a ship to another, as from the cabin to the engine-room or deck, by means of two dial-plates, on the faces of which *words* are engraved, expressive of the orders most commonly required to be transmitted, as "coals," "lights," &c., and two reciprocating index hands, connected by an intermediate arrangement of bands, pulleys, &c.

We mentioned in our last volume, (page 592,) the introduction of a hotel telegraph, on this principle, in America; and in our own country, similar modes of in-door communication have been long in use, with the difference—which we can hardly call an improvement—that the present patentee makes use of *words* on his dial-plates, which must necessarily be few in number, while in previous contrivances numerals, or other arbitrary signs capable of expressing a vast number of words, have been employed.

WILLIAM COTTON, OF LEYTONSTONE, ESQ., *for an improved weighing machine.* Patent dated June 13, 1842; Specification enrolled August 10, 1842.

Mr. Cotton, who is Governor of the Bank of England, has invented this machine for the purpose of weighing sovereigns, and separating the light ones from those of standard weight. It is so delicate, that it detects, with precision, a variation of a twelve thousand two hundred and fiftieth part of the weight of a sovereign. The coins are placed in a tube, or hopper, from whence they are carried on to a small platform, which is suspended over a delicately-poised beam, to the other end of which is appended the standard mint weight. On setting the machine at work, a sovereign is placed on the platform, and if it is full weight, a small tongue advances, and strikes it off into another till appointed to receive it; but, if it is light, the platform sinks, and brings it within the reach of another tongue, at a lower level, which advances at right angles to the former tongue, and pushes the coin into another till. Other coins succeed in rapid rotation, so that the machine can weigh and sort 10,000 sovereigns in six hours, while an experienced teller can at the utmost only weigh between 3000 or 4000 coins by hand-scales in the same time, and even then, the optic nerve, by incessant straining, becomes fatigued, and errors occur.

JOHN SEALY, OF BRIDGEWATER, MERCHANT, *for an improved tile.* Patent dated July 3, 1842; Specification enrolled January 3, 1843.

In the manufacture of this tile the dresser ordinarily used is dispensed with, and the tile, after it has been roughly moulded, and before it is quite dry, is placed on a dressing-

table or horse, the upper surface of which is formed according to the permanent form desired to be given to the tile; after which, a roller of a corresponding form, and worked by hand, is passed to and fro over the surface of the clay. Tiles, when thus made, are stated to have "an uniformity of thickness, a regularity of form, and a smoothness of surface, not possessed by tiles made by the use of the dresser."

RICHARD HODGSON, OF MONTAGUE-PLACE, GENTLEMAN, *for improvements in obtaining images on metallic and other surfaces.* Patent dated July 7, 1842; Specification enrolled January 7, 1843.

Images produced on "metallic and other (reflecting) surfaces," by means of reflecting mirrors, as in the ordinary camera, are caused to pass first through an interposed achromatic lens, by which "much of the spherical aberration is corrected, and the chromatic is greatly diminished." Or, the image to be reflected is passed through a meniscus, (of 14 inches focus,) fixed on a tube, by which "the convergence of the rays is increased." Or, lastly, in the case of the refracting camera, an achromatic object-glass is formed by combining a double convex lens of crown glass with a prism of flint glass, and a correcting lens is introduced behind the prism, which gathers the rays to a shorter focus.

JAMES CRUTCHETT, OF WILLIAM-STREET, REGENT'S-PARK, ENGINEER, *for certain improvements in manufacturing gas, and an apparatus for consuming gas.* Patent dated July 12, 1842; Specification enrolled January 12, 1843.

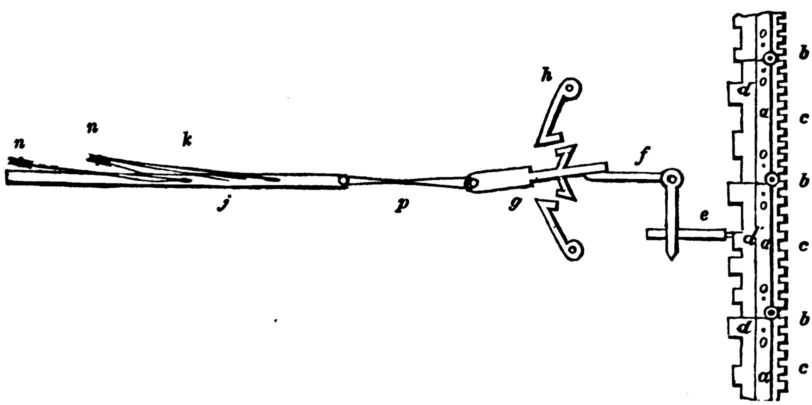
The "improvements in manufacturing gas" consist in producing, by a peculiar apparatus, described by the patentee, a triple compound, composed, first, of coal or other gas; secondly, atmospheric air, (in the proportion of from 5 to 15 per cent.;) and, thirdly, vapour of naphtha, or other volatile hydro-carbon, (in what proportions is not stated). The most remarkable feature in the apparatus employed for this purpose is, that the moving power which actuates it is the gas itself.

The improvements in "apparatus for consuming gas" consist in substituting for the ordinary concentric rings a spiral coil, "by which the light is equally concentrated, with the advantage that only one inlet-pipe is required."

WILLIAM CROFTS, OF NEW RADFORD, LACE MACHINE MAKER, *for improvements in the manufacture of figured or ornamental lace.* Patent dated September 8, 1842; Specification enrolled March 8, 1843.

The patterns for the figured lace are to be formed in the manner represented in fig. 1.

Fig. 1.



a a are boards joined together by the hinges *b b*; upon the back of these boards there is a toothed rack *c*, which works in a wheel situated upon the top of the machine, and by which they are put in motion. The thin plates of metal, *d d*, are cut with various indentations and projections, so as to produce the required pattern. Mr. C. states that he is aware that such plates have been before used for the same purpose, but they were permanently fixed; while he has his plates quite detached, though capable of being fixed to the boards *b b* by the pins *o o*, so that they can be easily removed when required, and made available in the construction of other patterns. Into the various indentations in these plates the thin plates *e e* fall, or they are raised up by the projections. The bell-crank *f* is acted upon by a projection or shoulder on *e*, and is elevated or depressed

according as *e* is thrust out, or allowed to fall back. The catches *h* and *i* are wrought by a cam placed on the main shaft, the connexion being formed with a rod and lever. In the position of the catches *h* and *i*, as represented in the figure, although they are worked by the cams, they have no effect upon the plate *g g*, (which has two wings or projections, one on each side;) but suppose that the bar *e* is thrust out by one of the projections on the thin plate of the surface pattern, then the shoulder upon *e* presses upon the bell-crank, and raises the plate *g*, which will then be drawn forward towards the surface pattern, and, being connected to the bar *j* by the thread or fine wire *p*, the bar *j* will also be drawn forward. Had the bar *e* fallen into an indentation in the surface pattern, instead of being thrust out, then the plate *g* would have fallen down, and have been acted upon by the catch *i*, which is wrought with a separate cam and lever from *h*, yet still the action upon the bar *j* would have been the same.

The selecting instruments *m* are joined to the bar *j* by the threads *k k*, passing over the small pulleys *n n*, as shown in fig. 2.

The bars *e* and *j* are kept in their proper places by combs, so that they may not pass each other, or the bell-crank *f*.

Fig. 3 shows the position in which Mr. C. has his additional point placed, working by means of cams in connexion with the back and front points.

In fig. 4, *a* and *b* are cards of a Jacquard lace-machine; *d*, the driving-wheel; and *c* and *e*, the two driven wheels, giving motion to *a* and *b*; *f f* are wires falling into the

fig. 2

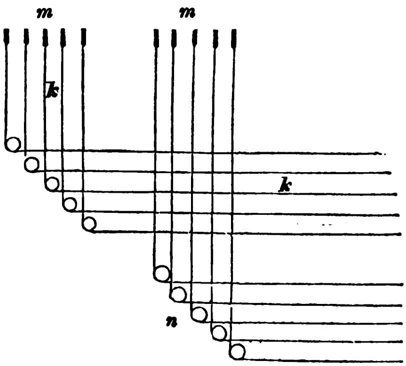


fig. 3

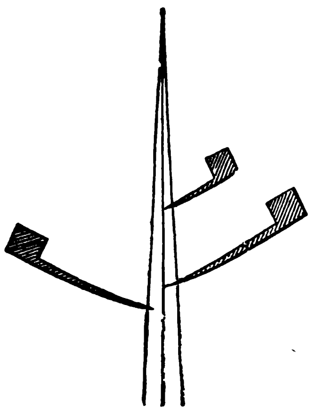
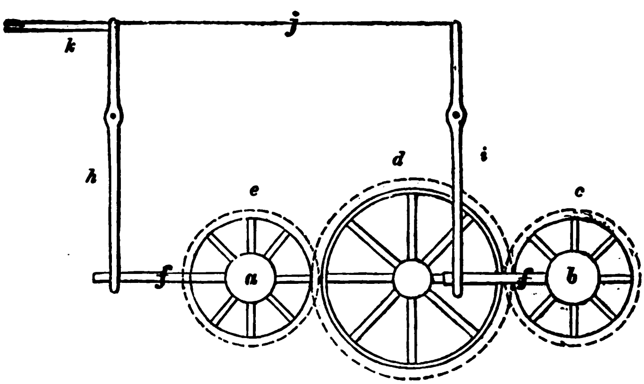


fig. 4



holes which are cut in *a* and *b*, or, where there is no hole, the wires are thrust out, and press upon the under ends of the levers *h* and *i*, which pull the wires or threads *j*

and *k*, and so act upon the instruments which select the various parts of the warp to produce the intended pattern.

fig. 5

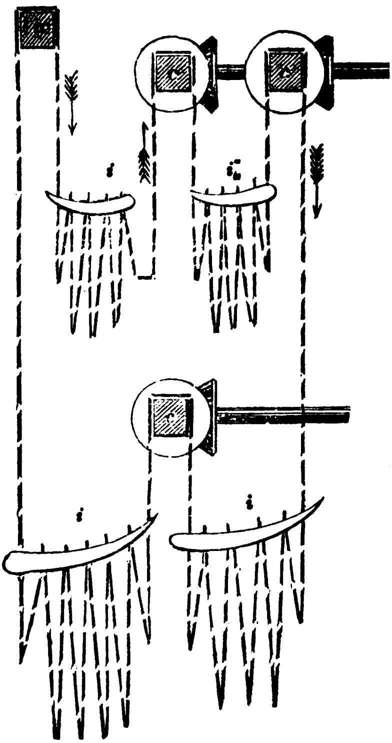


Fig. 5 represents a chain of cards, attached to each other at the edges; between every fifth there is a wire projecting so as to rest on the supports *i i*. It will be seen by reference to the figure, that, as the bevel wheels travel at the same speed, the chain will be carried over *a c c c* uniformly, and the chain of cards will always present the same appearance, although moving round, being guided in their course by the supports *i i i i*. But, from the variety of pattern on the cards, as they come upon *a*, the pattern in the lace will be changed, *a* being the place where the instruments for selecting the warp are acted upon by the pattern cards.

Mr. C. states that, by the introduction of moveable pins, he has a method of producing varieties in the patterns of traversed surface lace; and that he can, also, by the same means, introduce additional warp threads.

The patentee claims, 1. The making up of surface patterns with plates of thin metal having various surfaces, which surface patterns admit of being easily broken up, and of the materials being again used in the formation of other patterns.

2. The arrangement of the machine as represented in fig. 1, whereby it is worked with greater speed.

3. The using of additional points in connexion with the back and front lifting points, so as to allow of their being removed from the warp at the same time.

4. The use of the long bar *j*, as described in fig. 1.

5. In the manufacture of lace where the patterns have to be changed, the application of the arrangement shown in fig. 4.

6. The application of a chain of cards in the manufacture of lace where the pattern can be changed, in the manner illustrated in fig. 5.

7. The producing of a traversed surface lace, (by the means before explained.)

8. The introduction of additional warp-threads in lace, (also by the means before explained.)

ON COMETARY AND ZODIACAL PHENOMENA.—BY SIR J. S. W. HERSCHELL, BART.

(From the *Times*.)

Sir,—As an opinion seems to have obtained a pretty general currency, that the light which others as well as myself have regarded as the tail of a great comet is, in fact, nothing more than the zodiacal light, and as I have received a great number of letters and other communications suggesting this explanation, which has also been advanced very unhesitatingly, and as a matter hardly admitting of dispute in some of the journals, especially in the *Liverpool Times* of the 28th inst., on the authority of Dr. Forster, now resident at Bruges (whose experience as a meteorologist would, I should have expected, have prevented him from assimilating two phenomena so utterly unlike), it may not be amiss if I request the attention of such of your readers as may feel an interest in the matter to the following reasons why such an explanation is inadmissible.

1. As I have said, the phenomena are so utterly unlike, that I do not understand how it is possible for any one familiar with the zodiacal light for an instant to confound them. The zodiacal light, as its name imports, invariably appears in the zodiac, or, to speak more precisely, in the plane of the sun's equator, which is 7 deg. inclined to the zodiac, and which plane, seen from the sun, intersects the ecliptic in longitude 2 sec. 18 deg. and 8 sec. 18 deg., or so much in advance of the equinoxial points. In conse-

quence, it is seen to the best advantage at, or a little after the equinoxes, after sunset at the spring, and before sunrise at the autumnal equinox, not only because the direction of its apparent axis lies at those times more nearly perpendicular to the horizon, but also because at those epochs we are approaching the situation when it is seen most completely in section.

At the vernal equinox the appearance of the zodiacal light is that of a pretty broad pyramidal, or rather lenticular body of light, which begins to be visible as soon as the twilight decays. It is very bright at its lower or broader part near the horizon, and (if there be broken clouds about) often appears like the glow of a distant conflagration, or of the rising moon, only less red; giving rise, in short, to amorphous masses of light, such as have been noticed by one of your correspondents as possibly appertaining to the comet. At higher altitudes its light fades gradually, and is seldom traceable much beyond the Pleiades, which it usually, however, attains and involves; and (what is most to my present purpose) its axis at the vernal equinox is always inclined (to the northward of the equator) at an angle of between 60° and 70°, to the horizon; and it is most luminous at its base, resting on the horizon, where also it is broadest, occupying, in fact, an angular breadth of somewhere about 10° or 12° in ordinary clear weather.

When, therefore, a beam of light, of a nearly uniform breadth, not exceeding a degree or a degree and a half at the utmost, inclined at an angle of not more than 25° to the horizon, and that not to the north, but to the south of the equator, and making an angle of 33° with the zodiac to the southward, instead of 70° to the northward of that circle,—when that beam of light, not increasing in intensity towards the horizon, but quite the contrary, is seen in the sky at or near the time of the vernal equinox, I think it will be granted at once that no observer familiar with the appearance of the zodiacal light, and bearing in his recollection its geometrical relations to our globe, could for a moment be deceived into regarding such a beam as any possible phase of the last-mentioned phenomenon.

But to come to particulars, I must now observe, that on Friday, the 17th, and on every evening since that time, when I have observed the comet, the zodiacal light has also been displayed in the most striking and perfectly characteristic manner; and, indeed, with a brilliancy which I should certainly be disposed to regard as a proof of the opinion generally entertained of its varying from season to season in intensity, were it not for the habitual and exceeding purity of the atmosphere in this favoured corner of our island, which is altogether free from smoke, and most commonly so from haze, and (in the absence of actual cloud) quite upon a par (so far as a three years' residence will enable me to judge) with that of any region I have visited.

The zodiacal light, then, on every occasion when I have seen the comet, has been thus superbly displayed, occupying its usual place among the stars, and having all its usual characters; while the comet, in no part of the extent of its tail, so much as touched upon the region occupied by it.

Furthermore, Mr. Cooper distinctly states that he saw the nucleus at Nice; and, as that gentleman has given proofs enough of his acquaintance with the appearance of comets, I cannot suppose him to have mistaken any other object for one.

Lastly, I have myself, on one occasion, distinctly seen the head with its so-called nucleus. In this also I could not be deceived. The telescope with which I viewed it (having no night-glass or comet-seeker at hand) was only a 20-inch achromatic of 1½ inch aperture, with a single lens for an eyepiece, and magnifying power of about 12 or 13, held in the hand. With this I found it, after no very long search, near a star which (misled at the time by the magnitude ascribed to ρ Eridani in Bode's map) I supposed to be that star, but which, on consulting better authority, I now consider to have been ζ (zeta) of that constellation, or possibly η (eta); after several times laying aside the telescope and contemplating the tail, as often returned to it, having not the least difficulty in finding it again.

But now comes the most remarkable circumstance attending the appearance, or rather disappearance, of this comet. The next night (Saturday) I prepared a 7 feet Newtonian reflector of 6 inches aperture on the roof of my house, expecting to obtain a good view of the nucleus. To my amazement, though the night was clear and the horizon good, I could not find it, but I did find, in the very central line of the train, near no star, nor in any identifiable place, a dim, pretty large, oval nebula, very little condensed towards the centre, but with no appearance whatever of a nucleus. This nebula I also several times swept over; so that I have not a suspicion remaining on my mind of the possibility of any illusion. Now, there are nebulæ in that region of the sky; but, on referring to a catalogue of them, I do not find one which I consider it would have been possible to have seen with such an instrument, and under such circumstances of remaining twilight and vicinity to the horizon. Moreover, the next night, (Sunday,)

taking up the observation earlier and pursuing it later, with the same reflector and an equally good sky, this nebula was also missing. These facts I consider as well worthy to be placed on record, and to indicate a rapidity of diminution in point of lustre only to be explained on the supposition that the comet is receding from us with great velocity. The train, too, is diminishing rapidly in brightness, though it retains its position with remarkable pertinacity; at least, it did so on Wednesday night.

I have the honour to be, Sir,

Your obedient servant,

J. S. W. HERSCHELL.

Collingwood, Hawkhurst, Kent.
March 31, 1843.

NOTES AND NOTICES.

An Enormous Steam-engine, by far the largest ever constructed, is now in process of manufacture at Harvey and Co.'s foundry, Hayle; the piston-rod, which was forged last week, is 19 feet long, 13 inches diameter in the middle, and 16 inches in the core; and weighs 3 tons 16 cwt. It will work in an 80-inch cylinder, which will stand in the middle of another cylinder, of 144 inches diameter. Five other piston-rods will work between the inner and outer cylinders. We conclude, for this has not been explained to us, that the piston of the external giant cylinder will be perforated in the middle for the 80-inch cylinder to stand in it, and will work between the two. The 80-inch cylinder was cast last week, and the large one will be cast soon. The pumps are to be 64 inches in diameter; a measurement which may afford some idea of the size of the engine. It is intended for draining Haerlem Lake, in Holland, and it is expected that other orders for similar engines will be received from the same quarter. It is truly gratifying to us to observe that Cornish engineers still keep so far in advance of all the world, and not less gratifying to see that foreign powers know and can appreciate their excellence. Let this wonder of engineering and mechanical skill be considered, as well as the duty done by our common mine engine; and it must be confessed that our Cornish mechanics are, in this branch, far in advance of every competitor; and we may reasonably hope, as superior merit must be appreciated at last, that our engine foundries will at length have their full share of public and government patronage.—*Sherborne and Yeovil Mercury.*

New Gas.—The *Censeur*, of Lyons, states that, at one of the late sittings of the municipal council, a trial was made of a new portable gas, to which its inventor has given the name of "hydroluminous." The apparatus, says this journal, is very simple, and applicable to the smallest candlesticks, as well as to the largest and most splendid candelabra. The light it gives is very fine, and it is so portable that it can be carried about with the common hand candlestick.

Mr. Williams's Argand Furnaces.—On the 25th ult. the "Pegasus" steamer made a trial trip, from Leith round Inchkeith, to prove the working of Mr. C. W. Williams's patent furnace for saving and consuming smoke, previous to her resuming her regular station betwixt Leith and Hull, in consort with the new steamer "Martello." The trial was very satisfactory indeed, there being a full supply of steam at 7 lbs. pressure, even while the vessel was light, and the engine running betwixt twenty-four and twenty-five revolutions in a minute. The usual blackness of the smoke was considerably reduced; and this particular will be entirely effected when the firemen have more experience in regulating the draught. One voyage or two will suffice for this; and it is confidently expected, from this short run, that a very great saving will be made in the fuel used in a voyage.—*Edinburgh Chronicle.*

Steam Navigation.—(From a correspondent of the *Mining Journal.*)—"A trial, on a small scale, has been made at Liverpool, of a new principle in the propelling apparatus of steam-vessels. The vessel in which the experiment was made was the *Dædalus*, a small yacht of 15½ tons burden, built by Mr. M'Ardle (a gentleman attached to the City of Dublin Steam Company), under the superintendence of Mr. J. C. Shaw, also connected with that extensive concern. Mr. M'Ardle is the inventor of the plan, which consists of an axle, provided with fanners or blades, placed in a peculiar position, and revolving in an aperture in the dead wood of the stern; this propeller is turned by two four horse engines—also on a new principle—the cylinders moving from side to side on joints below, so that the piston-rods pursue and act upon the cranks, without the necessity of the parallel gear required in upright fixed cylinders. The principle seems to be well adapted for canal-boats, inasmuch as there is no surge made in the wake, or at the sides, as with the paddle-wheel, to wash against and break down the banks. The inventor is of opinion that the propeller may be altered and modified, so as to be more peculiarly suitable either for canal craft or sea-going vessels."

The Comet.—Mr. Glaisher, of the Cambridge Observatory, has disclaimed the letter which appeared with his signature in the *Times*, and which we quoted in our last, as leading to the conclusion that "the comet (was) no comet." Mr. Hind, of the Greenwich Observatory, states that "since the 17th of February the comet has passed through an arc of 169 deg. of true anomaly, with a direct, and not retrograde, motion." He adds, "In consequence of the comet's slow motion in right ascension, the sun is gradually approaching its apparent place, and hence it is not likely to remain long a conspicuous object in the heavens, especially since the distance from the earth is rapidly increasing. On the 27th of February the comet was within 1,100,000 miles' distance from the sun, according to M. Galle's determination of the perihelion distance. This is a closer approach than any on record, with the exception of that of the great comet of 1680."

The Thames Tunnel, after being in course of construction for a period of seventeen years, has at length been so far completed as to be opened for foot-passengers. The greater difficulty has yet to be overcome, namely, that of making the undertaking as profitable to the share-holders as it is creditable to the skill and ingenuity of the architect, Sir M. I. Brunel. The original calculation was, that it would pay 4 per cent. on an expenditure of about £250,000; the actual cost (when the carriage-ways are completed) will be not less than £620,000. Besides, when that calculation was made, steam navigation was comparatively but in its infancy; and the risk was then scarcely contemplated, which is now imminent, that the moment a stream of traffic takes the direction of the tunnel, steam ferry-boats will begin plying overhead, and carry off the bulk of that traffic. The excavation made for the tunnel was 38ft. broad, and 22ft. 6in. high, presenting a sectional area of 850ft.; the interior horizontal diameter of each arch is 13ft. 9in.; and 15ft. 4in. vertical; depth at the shaft on the Rotherhithe side, 63ft., and declining towards the centre of the river 2ft. 3in. per 100ft.; the base in the deepest part being 76ft. below high-water mark; the length is 1200ft.

Errata.—In the letter on Punctuation, p. 198 of our present vol. col. 1, line 19, for "trivial has been the taxation," read "trivial has been the abolition of taxation;" and ":———" ought to have been numbered "9," and ".—" "10."

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1027.] SATURDAY, APRIL 15, 1843. [Price 3*d.*

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MR. HENSON'S STEAM BOILER.

Fig. 1.

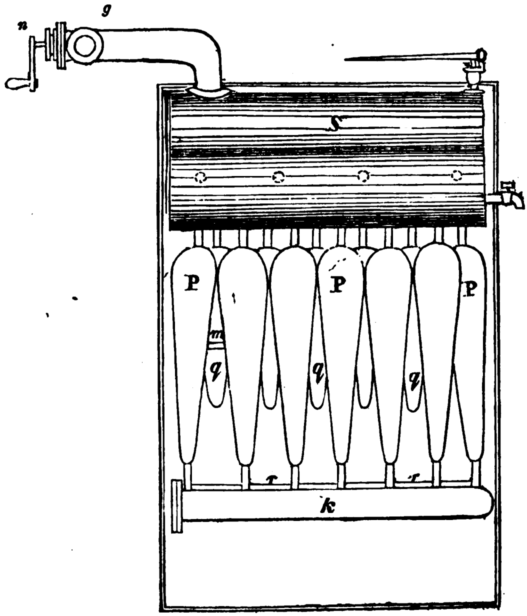
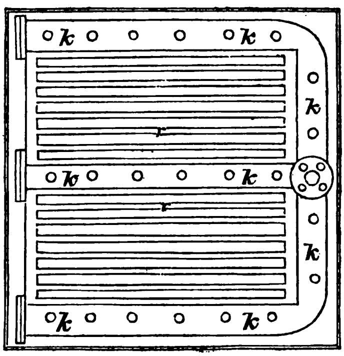


Fig. 2.



THE STEAM POWER OF MR. HENSON'S FLYING MACHINE.

FROM the different papers we have given on the subject of Mr. Henson's scheme of aerial navigation, or to which it has given rise, our readers will have seen that the difficulty of mechanical flying, consists less in devising an apparatus capable of floating in and being moved through the air in any given direction, as in freighting it with mechanical power sufficient to enable it to maintain its place through long distances, against the constantly adverse influence of gravitation, and the frequently concurring opposition of the wind and weather. The means by which Mr. Henson hopes to overcome this difficulty, that is to say, the boiler by which he proposes to generate steam enough for any given length of flight, deserve, therefore, a little more consideration than they have as yet received at our hands; the more so, as, in consequence of the haste under which our first notice of it was unavoidably penned, that notice was in some respects erroneous, and on the whole less just than it is always our wish to be. We now make the best amends in our power, by laying before our readers the accompanying engravings of the boiler, with the explanations furnished by Mr. Henson himself in his specification.

Fig. 3.

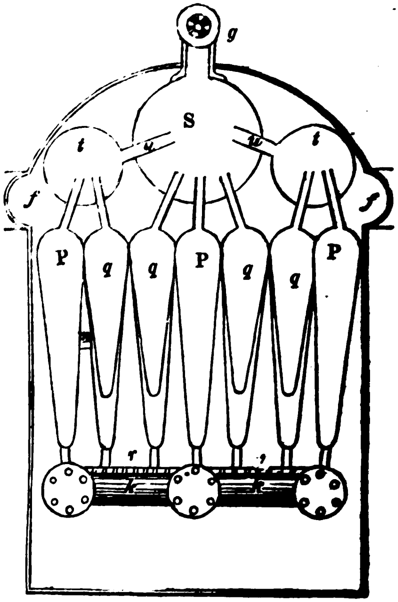


fig. 4

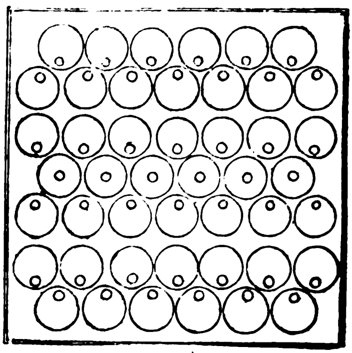


Fig. 1 represents a side elevation, and fig. 3, a front elevation of the boiler; figs. 2 and 4 are top and bottom sectional views.

S is the body, or principal part of the boiler, consisting of three cylinders, the steam from which passes off through the pipe *g*, which is provided with a valve. The smaller cylindrical vessels *t t* are joined by the pipes *u*, (four of which are indicated by dotted circles in fig. 1.) The larger conical vessels P P P connect the pipe *k k* and the principal cylinders of the boiler, in the manner shown in the figures. The smaller vessels *q q* are connected to the principal cylinders, as also to the vessels P P, as shown at *m*, figs. 1 and 3. The furnace is divided into two compartments by the vessels P P P, as seen in fig. 2. *r r* are the furnace-bars, resting on the pipe *k k*, so that the vessels P and *q* are subjected to the full power of the fire; *f f* is the place of exit for the smoke.

The vessels S, *t*, P, and *q*, Mr. Henson proposes making of copper, and the joinings of brass, on account of the greater strength of copper when compared with iron, weight for weight, and also on account of its greater heat-conducting power.

The two induction and eduction valves of the engine, which are simply cocks varying little from the ordinary form, are to be worked by four eccentric wheels.

ON THE OBJECTIONS TO MR. HENSON'S PLAN OF AERIAL TRANSIT. BY L. L.

Sir,—The importance of Mr. Henson's object will be, I suppose, an ample apology for some further remarks on the principles involved in the art of aerial transit by mechanical means; and perhaps such remarks as I may have to offer will best take the form of comments on other papers.

Before I proceed to matters of greater importance, permit me to point out the extraordinary and thick-set blunders of an article which first appeared in the *Artizan*, and afterwards, retouched, in the *Illustrated London News*; if it had not been extensively circulated by the last-named popular publication, it would not have been necessary to notice it.

In the *Artizan*, the writer asserts that Mr. Henson's machine will require a power of 701 horses, and that his conclusions on this head are based on physical laws, the truth of which cannot be disputed for a moment. For the present, allowing him his physical laws, let us see with what correctness he applies them. He says, first, that the kite has the greatest sustaining power, when fixed at an angle of 45°; which is not true, as Maclaurin and others showed a century ago. But let it be so: we are told that "the perpendicular area of the kite," (that is, area × by the sine of 45°,) "exposed to the action of the wind, is 3,213 feet" (not exactly correct, but let it pass;) "and that the total pressure on it at 60 miles an hour is 13·144 lbs. Now, this sum cannot be made out by a just reckoning, but by a little inquiry we shall find out the blunder, and how it was made. The pressure on a perpendicular surface, at 60 miles an hour, is 17·715 lbs. per square foot, as we learn from Rouse's Table, of which some items are quoted in the *Illustrated News*. But this pressure, even when multiplied by the square of 45°, gives 28·460 lbs. for the total pressure, or more than double the amount at which he states it. The mistake probably arose from this circumstance: some tables derived from Rouse's give the force of the wind, not as is generally done for velocities, at miles per hour, but at feet per second; and in them the pressure per square foot, for *sixty feet per second*, is 8·234 lbs. This erroneous multiplier and the square of the sine very nearly give the assigned pressure of the 13·144 lbs. Again, at 45°, whatever it may be as thus derived, it is really both the resistance to flight and the resistance to falling, they being equal at that angle; this did not occur to our acute computer, and therefore he resolved it again into two equal portions, (and that by guess, for neither rule nor reason would so divide it,) one of which, or 6,572 lbs., he says, is all the machine will bear: correct resolution (if any could be correct where none was admissible,) would have given 9,294 lbs. Finally, 1,760 is taken as the number of feet instead of yards in a mile, and the resulting amount of horse power, is, therefore, but one-third of that which this step should make it, or but 701 instead of 2,103 horses. It must require extraordinary talent to squeeze five blunders so gross into twelve short lines.

In dressing this article over again for the *Illustrated News*, the greater part of these errors are huddled together in the supposition of the pressure being 13,000 lbs. on the sine. The false and inadmissible resolution is retained, and the blunder of taking yards for feet is transferred in the inverse sense to the estimate of horse power: 33,300 lbs. raised one *yard* per minute being taken as its measure. It was necessary to make the results agree. If these principles had been correctly worked out the weight supported and the resistance to flight would each have been $= \overset{\text{feet.}}{4500} \times \overset{\text{lbs.}}{17{\cdot}715} \times \sin.^3 45^\circ = 28185$ lbs., which is more than nine times the sustaining force required; and the necessary engine power would have been

$$\frac{\overset{\text{lbs.}}{28185} \times 60 \times 1760 \times 8}{60 \times 33000} \quad 4510$$

horses, nearly, instead of 701!

It may show the value of the same principles to remark, that according to them, a bird whose sustaining planes are equal to one square foot, and which flies at 60 miles an hour, weighs more than 6¼ lbs., and exerts in its flight, besides the extra labour of the start, a force of a little more than one-horse power!!! The authorities I quoted in my former paper are sufficient to show the confidence due to these indisputable principles: I add to them only the article on Seamanship, in the *Encyclopædia Britannica*, by Professor Robison, according to whom, if they were true, no square-rigged ship could ever beat to windward!

It may be amusing, if not instructive, to collect for comparison some of the various determinations of the amount of power required by Mr. Henson's machine: we may at least learn, from the diversity, that on this subject nothing certain is generally known.

	Horses-power.
The writer whose lucubrations we have just illustrated, rests on principles which, if accurately applied in his own mode, would show a force to be requisite of	4510
He reduces, however, a result of	701
The *Mirror* of April 8, requires	247
Sir G. Cayley, for sustentation only	114
The common theory incorrect in itself, but correctly applied to the case of 50 miles per hour, and for propulsion only	100
The *Athenæum* of April 8, for sustentation only	60
Sir W. Congreve, *Mech. Mag.*, March, 1828, for carrying 8 or 10 men 1200 miles a-day, including sustentation and propulsion	3

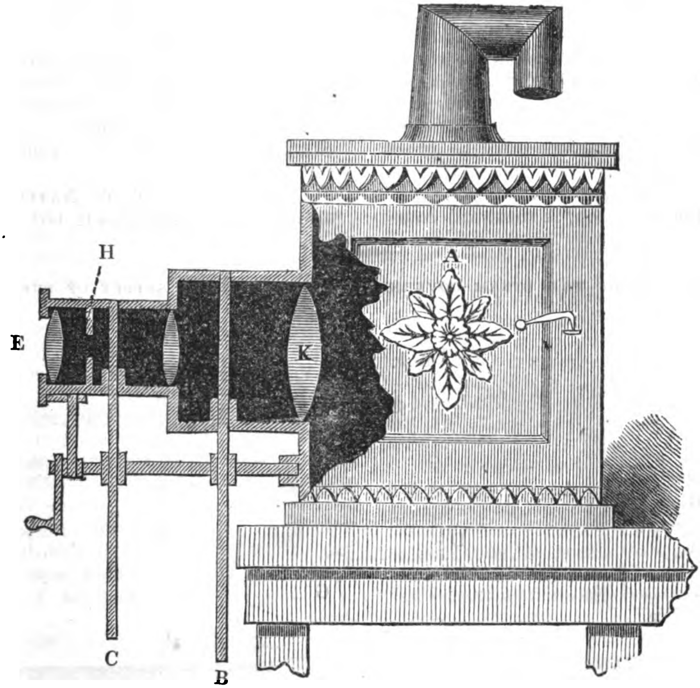
Surely any guessing would prove as good a guide as this uncertain reckoning: and since none of these conclusions present any conformity to the observed facts connected with the flight of birds, it is at least as reasonable to believe in the likelihood of Mr. Henson's success now, as it was before they were published. In all probability, the principles assumed in each of them are radically defective, and therefore insufficient for the inquiry. Further discussion, however, will bring out the truth: my object in exhibiting these learned disagreements, is to show the necessity for that further discussion.

The letters of Sir Geo. Cayley, in your last two Numbers, like those of the same writer, published eight-and-twenty years ago, are evidently the production of steady and expansive thought, united with an ardent desire to be useful: to promote the important cause of Aerial Locomotion, is with the scientific baronet an object pursued with a benevolence of intention which admits of the existence of no personal jealousy or thwarting envy. It is no ordinary pleasure to discuss, with such a writer, the principles of applied science.

Intending no remark on the particular construction of the flying machine proposed by the talented and worthy baronet, I beg to notice, perhaps not in very exact order, some matters of principle suggested by passages in his last letter. And first, as to the mode of investigation, is there really much to be learned from the *precise* angle with the line of flight assumed by the bird's wing? And are not many of the remarks lately made by various writers about the great muscular power of birds very likely to mislead us? Birds of different kinds fly very differently: at one extreme we have the slow and easy stroke of the bird which hovers long over the water; at the other, the few sharp strokes, given for an instant, so as to lift the bird with a curve in its flight, and then intermitted, so that it sinks again, which is exhibited by the smaller birds of the fields and hedgerows. In each case the mode of flight has to be accommodated to the habits and wants of the animal, and the diversities of the modes are produced by the combination, in different proportions, of the effects of distinct principles. There seems little doubt that the sustaining of the long-flight bird is chiefly effected, as Sir George Cayley states, and as Mr. Henson proposes, in his machine, by the oblique impact of the air on the inclined front surfaces, while, in the leaping intermittent flight of some smaller birds, the sustentation, is as clearly the effect chiefly of the downward bent of the wing. Now, to arrive at conclusions necessary and sufficient for our guidance in artificial flying, by observations derived from nature, we must be able to analyse correctly the different modes of flight, and assign its share, in every case, to each of the principles I have mentioned, and perhaps to others. To do this, we must know correctly the very quantities and kinds of pressure, which it is the object of the investigation to ascertain. If direct experiment had put us in possession of this knowledge, we might then easily classify, and account for natural appearances, and as easily predict the issue of any artificial attempt to fly. The principal relation of natural flight to this subject, seems to be this,—no theory can be true whose consequences can be shown to be inconsistent with observed facts; and, much further than this, I fear it will not at present help us.

(To be continued in our next.)

PHANTASMAGORIA FOR THE EXHIBITION OF MOVING FIGURES.



Sir,—I enclose a sketch of a phantasmagoria, on a new principle capable of showing figures moving with all the appearance of life and reality.

The part A is shaped exactly after those of the ordinary construction, and is fitted with a condensing lens K, and either an Argand lamp or the Drummond light. B, is a flat circular piece of glass, of a foot or more in diameter; it is divided into a convenient number of compartments of equal size and shape, on all of which, the same figure or figures are painted. In each repetition, the figures are gradually changing into another position, which attained, they pass with the same regularity into the attitude they first commenced with. C, is a circle made of tinned iron or card-board, and fixed on the same axis as the glass B; around it, and near the edge, as many holes are cut, as are repetitions of the painted figures; both these circles are made to fit accurately to one axle, in order that they may be moved round together, by means of the winch G: and the arrangements must be such as to cause each (succeeding) picture on the glass B, and its corresponding hole in the circle C to be coincident; the former with the focus of the compound object-glass E, and the latter with the diaphragm or stop H, employed for limiting the aperture, and separating the two lenses.

The figures will necessarily require to be drawn with the greatest degree of exactness, both with regard to position and similarity of form. The plan I adopt, and which I find a very good one, is to provide a few of those optical toys called "Phenakisticopes," (?) and place on one of them a glass circle previously obscured by grinding; then trace on the latter the outlines of the drawing, which must be afterwards painted in transparent colours mixed with oil-varnish, which, from its refractive power, causes the dull surface of the glass to resume its pristine transparency. The remaining portion of the glass should be obscured with thick black paint.

The toys mentioned above may be

readily had, I believe, at most respectable stationers. Some of those I have seen bear the mark of Ackermann and Co., the eminent printsellers of the Strand. The subjects (of my selection) consist of 1st: A fat gentleman feeding, and a dog springing up to snatch his plum-pudding. 2nd, Turn-out of a nest of serpents, which are gliding off with great exactness. 3rd, A lady and gentleman waltzing. 4th, Quadrille dancers. 5th, Indian juggler. 6th, A theatrical combat between two bravos. 7th, A comic figure representing a man beating the big-drum with all the characteristic antics. 8th, A bell-ringer.

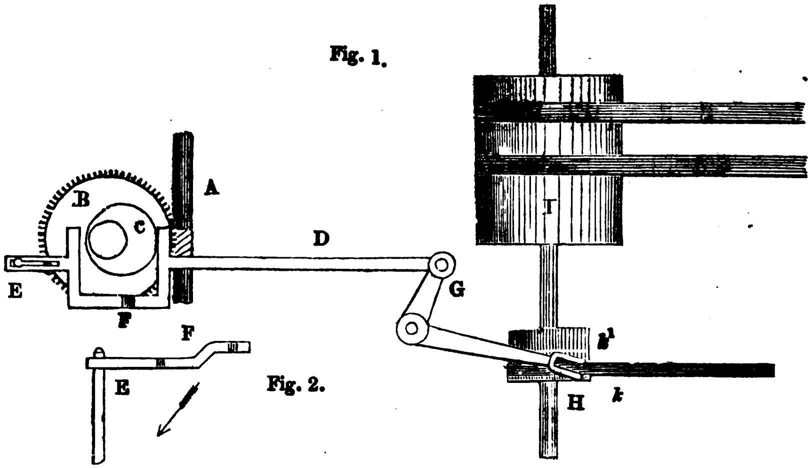
If you consider the plan to have any degree of originality, please favour me with the insertion of the description of the same as early as convenient.

Sir, I have the honour to be, your very obedient servant,

T. W. Naylor.

Newcastle-upon-Tyne, February 12, 1843.

APPLICATION OF THE STEAM GOVERNOR TO REGULATE THE SUPPLY OF FUEL.



Sir,—As it is highly desirable that the steam engine should be made as *automatical* as possible, I consider that the supply of coals requires equally as much regulation, as the passage of the steam through the throttle-valve. With a view to the carrying out of this design, several plans have been proposed for regulating the supply of coals, but they are generally worked according to the pressure of the steam, that is to say, when the steam is low, the furnace is supplied, and when it is high, that supply is cut off. Now every one at all acquainted with the subject knows, that it is very often the case, that the steam may be at its full pressure, yet from several incidental causes, the engine may not be going its proper speed. To obviate this objection, I propose to make use of the governor, instead of the pressure of the steam, for the above purpose, and in such a way that it will always regulate the supply according to the speed the engine may be going, whatever the pressure of the steam may be. Prefixed is a sketch of a plan, more particularly applicable to stationary engines, to which the governor is applied, to set on, or stop the supply of coals through the hoppers.

A is a shaft driven by the engine, and carrying a worm, or endless screw, which works into the wheel B; on the shaft of this wheel, is fixed an eccentric C, which fits in between the cheeks of a frame (not in the same plane) fixed to the rod D, which works the hopper strap. The governor rod is attached to this frame at E, which is slotted to allow the frame to move independently of the governor rod; G is a bent lever, to one end of which is fixed the frame rod, the other carrying the strap fork, H, for shifting the strap from the fast to the loose pulley, and *vice versa*;

I is the drum carrying the straps for working the hoppers, being fixed on the same shaft as the fast and loose pulleys *k k'*.

In fig. 2, F is the eccentric frame, showing the bend in the middle, so that the two cheeks may not be in the same plane; E is the governor rod, which may be attached to the throttle-valve rod, to avoid any complex alterations in the governor.

The *modus operandi* is as follows:—When the engine is going too slow, and the governor balls are down, the push of the governor on the rod E, will draw the frame on one side, in the direction of the arrow, thus causing the cheek *x* to come in contact with the eccentric, which by its revolution will push the rod into the position shown, and put the strap upon the fast pulley *k*, and so set the hoppers in motion. If, on the contrary, the engine is going too fast, the push of the governor rod will cause the contrary side of the frame to come into contact with the eccentric, and will draw back the rod, shifting the strap from the fast to the loose pulley, and so stop the hoppers. I am, yours truly,

WILLIAM JOHNSON.

Preston, April 3, 1843.

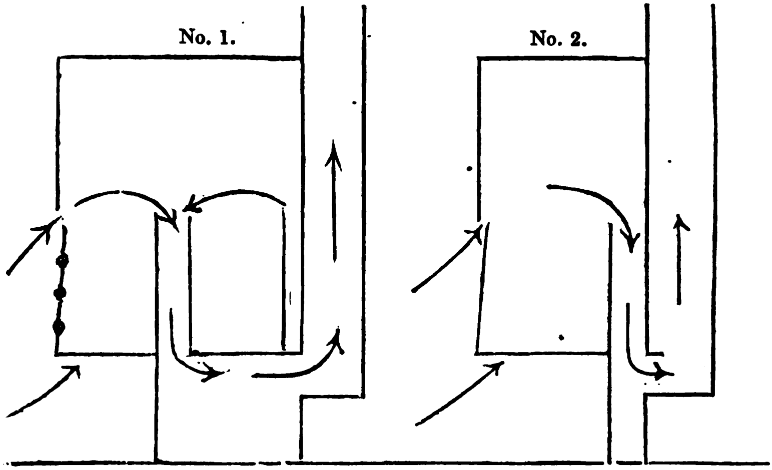
IS THERE ANY POWER IN VELOCITY ALONE?

Sir,—I really cannot see where the absurdity lies which you ascribe to Mr. Pilbrow's theory of the existence of a power in mere velocity alone. Not to insist on the analogy presented by falling bodies, since the direction of the motion in that case is downwards, what do you say to that of the trumpet—not "Scalpel's," though of verity he blows it nobly—but the better known speaking-trumpet? Roar as loud as you please, with your mouth open to the external atmosphere, you will not be able to make yourself heard at a horizontal distance of more than from 100 to 200 yards; but clap a well-proportioned trumpet to your mouth, and you may convey your orders to more than ten times that distance. Alexander the Great is said to have had a horn by which he could make himself distinctly heard at the distance of twenty-five miles! And our own Sir Samuel Morland made *toys* of the sort, which conveyed words to the distance of thousands of yards. If it be true, then, as you assert, that a current of steam gains nothing from velocity, (including, of course, the concentration necessary to give it that velocity,) how do you account for the fact, that the motion given by the voice to the column of air, (which is, you know, "but a fluid of another description,") acquires a force by means of the trumpet, which the mouth itself could not give to it? It seems to me, with due submission, to be as incontestible as any thing either in Newton or Cocker—(I place Newton first, but, seeing *who* "Scalpel" has placed beside Columbus and Watt, I am not quite sure that the order should not be reversed)—that if, by the use of a trumpet, I can make myself heard at *double* the distance, (say that only,) which I could without it, then is the trumpet literally and truly the means of doubling the power of my voice. I am, Sir, &c.,

DUPLEX.

P.S.—The illustration which "Scalpel" gives from the village bells, which were heard in the midst of the vast Atlantic, is very beautiful and touching; but there is one important feature in the case which he seems to have overlooked—the bells were *cavities, not flat plates*—very like (not whales, but) trumpets.

[For a person evidently half in earnest, half in jest, "Duplex" has adopted a most appropriate signature. But, for the sake of the earnestness there is in his letter, we shall so far excuse the jesting, as to add a few words in serious reply. The increase of effect obtained by means of the trumpet is obtained, as he admits, by the concentration of the power of the voice into one focus; and such increase of effect from concentration we have never denied, though in the case of steam applied through pipes, instead of wide cylinders, we say it is far more than counterbalanced by the greater loss from reduction of temperature, friction, &c. Ozanam contended much in the same way as Mr. Pilbrow does now, that tubes serve to "strengthen the activity of natural causes—that the longer they are, the more energy is increased," &c. But this, as Montucla justly observes, and Hutton repeats, "*is not speaking like a philosopher—it is taking the effect for the cause.*" Of the increase of effect obtained by the speaking-trumpet Montucla gives the following explanation. "As the air is an elastic fluid, so that every sound produced in it is transmitted spherically around the sonorous body, when a person speaks at the mouth of the trumpet, all the motion which would be communicated to a spherical mass of air, (of four feet radius, for example,) is communicated only to a cylinder, or rather cone of air, the base of which is the wider end of the trumpet. Consequently, if this cone is only the hundredth part of the whole sphere of the same radius, the effect will be as great as if the person should speak a hundred times as loud in the open air. The voice must therefore be heard at a distance a hundred times as great."—ED. M. M.]



Sir,—Some communications have lately appeared in your Magazine on a subject of much importance, both in domestic and civic economy—combustion in common stove grates, in which, notwithstanding great improvements have of late years been made, much remains to be done for the more perfect combustion of the fuel, and the useful application of the heat in warming our houses.

There are four desiderata connected with the subject of domestic fires,—viz. 1. The economy of the fuel, as consisting in its perfect combustion; and consequent on this (2) The prevention of smoke; 3. The economy of heat, in its useful application in warming the air of our houses, in opposition to its dissipation in the atmosphere through the chimney; 4. Free ventilation, in opposition to the close confined air of a stove-heated apartment.

In the ordinary construction of fire-grates and chimneys, none of these desiderata are obtained except the last, and that one often in a very uncomfortable way, by a strong draft between the door of the room and the fire-place, exposing whoever may be sitting in the line of it to take cold; at the same time the greatest portion of the heat of the fire is dissipated up the chimney, and every part of the room remains chill and uncomfortable except in close proximity to the fire, and within the range of its *direct* influence. Thus the third desideratum is sacrificed to the fourth.

The evil just complained of is much abated by the use of register or stove grates, by which a considerable portion of the heat is arrested and reflected back into the room; and I should think Mr. King's stove grate, described in your Number of the 10th December last, is well calculated to effect this end. Still there is ample room for improvement in this respect. With the best constructed stove grates, there must necessarily be a current of heated air and gases ascending by the chimney, which, as to any beneficial effect in warming the air of the house, is so much heat wasted. Part of the heated current passes up through the chimney, and is dissipated in the atmosphere. This arises from the materials of the chimney being generally bad, or slow conductors of heat, and incapable of abstracting the heat as fast as it is presented to them.* Part of it, however, is arrested and absorbed by the masonry of the chimney; but the temperature of the house is seldom perceptibly benefited by the absorption, from the combined influence of the slow conducting properties of the materials and their mass, or thickness; whence it re-

* Their conducting power is still further deteriorated by the lining of soot or carbon, generally allowed to be one of the worst conductors of heat.

sults, that, except in particular localities and circumstances, as the part of the chimney nearest the fire-place, or where powerful or constant fires are maintained, the heat acquired by the chimney is not transmitted through the wall, so as to effect the air of the apartments through which the chimney traverses; but when the fires are allowed to go out at night, it is again given out to the ascending current of *cold* air, (cold as compared with the temperature of the chimney, though warmer than the external air,) and dissipated in the atmosphere.

The adoption of better conducting and radiating materials for chimneys, and the disposition and arrangement of the latter in such a manner as to facilitate the communication of their heat to the air of the apartments, would go far to prevent this loss; and it would not be difficult, I think, to make such a disposition of them perfectly consistent with the decorative appearance of the rooms; at the same time that it should have the effect of distributing a certain degree of warmth to the upper rooms of a house, which would often render fires unnecessary where they are now nearly indispensable. For this purpose, instead of a series of tubular perforations in the wall for the chimneys of the different floors, let an open recess of requisite depth and from 4 to 6 feet wide be carried up from the lowest part of the house where a fire is to be placed to the top where the cap is fixed. In this recess, a single iron flue or chimney of suitable dimensions should be placed, but occupying only part of it, and the fire-grate of each floor placed in front of the flue, and communicating with it by an opening in the back for the smoke, as in Mr. King's stove-grate—every other part of the frame of the grate except the front, being perfectly close. The opening for the smoke should be fitted with a door or plate capable of being closed when fires are not used. From the fireplace upward to the ceiling, the recess may be concealed by a thin screen, flush with the rest of the wall, and perforated with ornamental devices, through which a free communication would be established between the air of the room and the recess, so as to obtain all the advantage of the heat radiated from the metal chimney and the frame of the fire grate. Whatever portion of the heated current ascending by the chimney might not be taken up by the lower part of the flue, or chimney, would be obstructed by the upper part, and influence the temperature of the room above: and a regulated communication, if thought necessary, might also be made from any room below to one above it through the flooring of the recess, by which any superabundant heat in the lower room might be transferred to the upper. The chimney would require to be swept only from the top and bottom, so that there would be no interference with the intermediate rooms in this unpleasant and dirty process.

If Englishmen could be induced to forego the cheerful appearance of an open fire, there is little doubt that the principle of Mr. C. Williams's argand furnace might be successfully applied to domestic stoves, so as to fulfil the two other desiderated conditions of perfect combustion and the prevention of smoke. As such a revolution in established national habits and associations is scarcely to be expected, I am afraid we must be content to put up with the smoke nuisance, unless the *ne plus ultra* of perfect combustion *in open grates*, be an attainable object. Your correspondent, "R. W. T.'s" remarks were, I think, directed to this point: but the subject is beset with practical difficulties; for we have to unite the conditions of bringing the air and combustible gases together at a temperature for ignition, under circumstances most adverse to obtaining such a temperature. When a fresh supply of coals is added to a fire, the under surface of the stratum is the point at which combustion commences; but not meeting with a free supply of air at that point, and smothered by the coals above, the gases can only issue through the interstices in the form of smoke, being cooled down below the temperature of ignition in their progress, and still further cooled down by the cold air they then come in contact with. Hence, it is only when the fire, in its upward course, comes near the surface, that the smoke begins to give place to flame, and presently after nearly all smoke disappears. In a furnace or stove we have not the same difficulties to contend with, because the whole interior of a furnace acquires a high degree of temperature, sufficient to

keep the gases in a state for ignition whenever a proper supply of air is presented to them; and it is the doing of this which constitutes the great merit of Mr. Williams's improvements in furnaces. If we could conduct combustion in an open grate in a manner analogous to a candle or lamp by keeping the combustion at the surface, and supplying the fuel or materials for combustion from below, as they were required, we should be little annoyed with smoke. I remember, many years ago, meeting with a suggestion (I think by Dr. Franklin or Count Rumford) which pointed to something of this kind. It was to construct a cylindrical grate, entirely of open bars, the ends forming the front and back, and the circumference, the top, bottom, and sides of the grate. It was to be suspended on pivots in the fire place so as to be capable of turning round and reversing the top and bottom. Part of the barred circumference was to be made to open and shut as a door for supplying fuel, which was to be done by turning round the grate so as to bring the door to the top, and the fuel being supplied, it was again to be reversed, by which the fuel was placed at the bottom and the fire at top. I doubt whether a coal fire could be made to burn downwards in this way, whatever might be the case with wood fuel.

Your correspondent "T. H. B.'s" communication in your No. of 26th November last, contains some useful suggestions for the improvement of stove grates. The recommendation to make the opening for the smoke at the back of the grate, instead of above, had been anticipated by Mr. King, and is an important improvement; inasmuch as being in a line with the top of the fire, the current of air is directed in close contact with the surface, and also through the interstices of the upper stratum of burning materials, which must greatly assist the combustion. I perceive Mr. King's grates are pierced with holes at the back, for the admission of air, which are not the most efficient means for that purpose. I should agree with "T. H. B." in thinking, that a corrugated back would be preferable, provided the corrugations were deep enough to form a clear channel for the passage of the air between the back and the fuel, and that they were not likely to get clogged and stopped up by ashes and coal-dust. As, however, this would be a very probable result, a more effectual way of admitting air to the fire behind, than either a pierced or corrugated back, would be to have an iron grating of vertical bars (corresponding with the grating of the bottom) placed half an inch or more from the back of the grate, sufficient to permit the ashes falling through the bars to descend to the ash-pit. The sides should also be done in the same way, unless the front bars spring directly from the back of the grate, in which case, of course, nothing would be wasted. A fire-grate with this addition would approximate the condition desired by "R. W. T.," of being *all front*, not only without any sacrifice or loss of heat, but with a positive accession to it, by the more perfect combustion it would ensure. For the more easy access of air to every part of the fire, the breadth from the front bars to the back grating should not exceed 6 or 8 inches; any enlargement would be better made by adding to the length rather than the breadth of the grate. The back should be made upright, not sloping; and the grate placed low in the frame. The frame itself, being supposed to be placed in a common fireplace, should not be imbedded in, or in close contact with, the masonry, but left with an air space all round, communicating with the air of the room; at the same time all communication with the chimney should be cut off by a plate of metal fixed across the throat, through which the flue of the grate should alone have communication with the chimney.

But though by these arrangements the stove grate may be much improved, both in turning to account the heat of the fire and in causing a more perfect combustion of the fuel, we have not yet succeeded in rendering the latter so perfect that no smoke shall be produced and given off at the chimney. To be able to effect this, with even a modified degree of the success that has attended Mr. Williams's efforts, would be an important step in advance, and the object is of sufficient interest to encourage any attempt to test its practicability. The only way which occurs to me, as holding out a prospect of accomplishing it, is by causing the mixed current of air and smoke, or inflammable

gases, to pass in close contact with the hot and clear part of the fire in the lower part of the grate before reaching the flue, by which means the temperature of ignition might be obtained. For this purpose the communication with the flue should be made on a line with the bottom of the grate, and a narrow passage or opening for the smoke or gases to descend, either through the middle of the grate, or between the fire and the back. The latter would be the most simple construction, but the former most likely to effect the desired end of igniting the gases; inasmuch as they would have to pass down between a double line of fire, so to speak. In either case it would be necessary that the front plate of the frame should come as low down as the top of the grate, to prevent the smoke being returned into the room; and it should also be made, or part of it, to move up and down, so as to be capable of being raised for supplying the fire with coals, and of being lowered to any extent in front of the fire, as occasion might require. Other details would be necessary to perfect the arrangement; among these, a secondary communication with the flue above the fire, to be opened for the exit of the smoke during the replenishing of the fire with coals, at which time the front plate would be raised, but kept closed at other times. But as my object is merely to explain the principle, the preceding observations will be sufficient, assisted by the prefixed diagrams, exhibiting a vertical section through the middle of the grate, from front to back; No. 1 representing the form of grate in which the smoke is carried down through the middle of the fire, and No. 2, in which it passes between the fire and the back of the grate—the arrows showing the direction of the current.

In your Magazine for October last appeared an account from the Journal of the Franklin Institute, of some experiments on chimney caps, one of which, the last of the series, and of very simple form, exhibited an extraordinary power of draft or rarefraction as compared with the others. A cap of that description, attached to the chimney, would, I think, materially assist in testing the effect of a stove grate constructed on the above principle.—I am, Sir, Yours, &c.

N. N. L.

April, 1843.

INSTITUTION OF CIVIL ENGINEERS.

MINUTES OF PROCEEDINGS—SESSION, 1843.

January 10.

"*Abstract of paper by Mr. Davison, describing the mode adopted for sinking a well at Messrs. Truman, Hanbury, Buxton, and Co.'s.*"

Mr. F. Braithwaite described the difference between the method employed in sinking the well for Messrs. Truman and Co., and that for Messrs. Reid and Co. In the former the bore was small, and would therefore only produce as much water as was procured from the veins through which it passed vertically; while the latter, by its larger diameter, permitted lateral galleries to be driven in the direction of the fissures in the chalk: thus forming feeders for the well, and at the same time capacious reservoirs wherein the water accumulated when the pumps were not at work.

He attributed the comparative failure at Messrs. Truman's, to errors in the mode of sinking; the length of the cylinders which had been attempted to be forced down was too great, and the lateral pressure had prevented them from reaching the chalk, so that when the pumps were set to work an undue quantity of sand was drawn up with the water, causing a cavity behind the brickwork, which at length fell in. The water having been pumped out to a lower level than was proper, the equilibrium between the water and the sand around the cylinder had been disturbed, and the "blow" of sand had ensued.

The New River Company had been advised to sink a well of sufficient diameter to enable them to excavate lateral galleries, but they had sunk their well in the Hampstead Road, of a small diameter; and although fissures had fortunately been traversed, which gave an ample supply of water, many of the difficulties encountered would, he contended, have been avoided by adopting the larger diameter, and sinking the cylinders into the chalk, before the pumping was commenced.

The supply of water at Messrs. Reid's well, had been sensibly affected by the recent proceedings at the Hampstead Road well, which was now being constantly pumped in order to sink it deeper.

Mr. Davison explained that a bore of small diameter had been adopted, because it was calculated that a supply of water, sufficient for the wants of the brewery, would have been obtained by it. The excavation to within 5 feet of the chalk was suggested by the sudden dropping of the cylinder. He believed that when (contrary to his express instructions) the level of the water was reduced by pumping to below a given point,

the sand from beneath the oyster-bed rushed in to restore the equilibrium within the cylinder, and thus caused the difficulties which he had to contend with.

During the last year the pumps had been at work 1616 hours, in which time 300,000 barrels or 50,000 tons of water had been drawn from the well.

Mr. Farey believed that the casualties in well sinking, generally arose from the sources which had been mentioned. Mr. Woolf encountered them when sinking the well at Messrs. Meux, (now Messrs. Reid's) Brewery. The pumping up of sand with the water, was there carried to such an extent as to cause an accumulation of sediment 2 feet deep in the liquor back, in 14 days, and ultimately the new well broke into the old one adjoining it.

Mr. F. Braithwaite explained that in the year 1814, the well at Messrs. Meux was pumped "to clear the spring," which caused a cavity of nearly 40 feet deep from the sides of the well, and endangered the stability of the buildings around. Piles were therefore driven to support the upper ground, and upon them the brick steining was carried up. If the cylinders had in the first instance been carried down to the chalk, before the pumping had commenced, this accident would not have occurred.

Mr. Vignoles remarked that the same question as to the relative merits of boring or sinking had been discussed at Liverpool, for wells in the red sandstone, and in practice it had universally been found that, by the latter system the best supply of water had been procured, particularly when side drifts had been made.

Mr. Mylne said that the works at the well in the Hampstead Road, which had been repeatedly stopped from accident, were now resumed as an experiment; the quantity of water obtained was more than could be drawn by a pump 12 inches diameter, 6 feet stroke, making 10 strokes per minute (= 294 gallons per minute). The spring was struck at about 234 feet below the surface of the ground, and when the engine was regularly at work, the water generally stood at within 20 feet from the bottom of the well. He coincided in the opinion of the advantage of a well of large diameter over one of small bore, as it permitted side excavations to be made in search of water. This plan had been pursued with success at Brighton.

Mr. Taylor observed that another of the advantages of the large diameter was, that the proceedings could be watched, and accidents could be more readily remedied; the opinion of all practical miners was, that the large diameter was cheaper, as well as better, than the small bore.

Mr. Clark promised an account and drawings of a well now sinking by him at the Royal Mint. The advantages of a large diameter were manifest to all practical men, particularly when the auger or "miser" was used, as it enabled the operation to be continued without pumping; the cylinders, in lengths of not more than 30 feet each, followed the "miser" down regularly, and as soon as they reached the chalk, the operation was considered safe; and as the "miser" did not excavate more than was due to the area of the cylinder, the equilibrium between the water within and the sand without the cylinder, was never disturbed. In a well sunk by him at Messrs. Watney's Distillery, the cylinders were 11 feet diameter; the "miser" used was 5 feet diameter, and was turned by twelve men at a time.

Mr. F. Braithwaite concurred in the advantages of using the "miser," he invariably employed it, and generally with success.

Mr. Farey believed that the "auger" or "miser" was first used in this country by the late Mr. Vulliamy* of Pall Mall, for sinking an Artesian well, into which there was an irruption or blow of sand, the effect of which was only overcome by this instrument.

"*Experimental Inquiry as to the Co-efficient of Labouring force in Overshot Water-wheels, whose diameter is equal to, or exceeds the total descent due to the fall; and of Water-wheels moving in circular channels.*" *By Robert Mallet, Esq., M. Inst. C. E.*

This paper is partly mathematical, and partly experimental. The investigation which it details, the results of which are given in ten tables of experiments, had in view principally to obtain the definite solution of the following questions.

1st. With a given height of fall and head of water, or in other words, a given descent and depth of water in the pentrough, will any diameter of wheel greater than that of the fall give an increase of labouring force (*i. e.* a better effect than the latter), or will a loss of labouring force result by so increasing the diameter?

2nd. When the head of water is necessarily variable, under what conditions will an advantage be obtained by the use of the larger wheel, and what will be the maximum advantage?

3rd. Is any increase of labouring force obtained by causing the loaded arc of an overshot wheel to revolve in a closely fitting

* Vide Nicholson's Journal of Philosophy, vol. ii., p. 266;—"An Account of the means employed to obtain an Overflowing Well at Norland House in 1794," by Benjamin Vulliamy.

circular race, or conduit; and if so, what is the amount of advantage, and what the conditions for maximum effect?

The author briefly touches upon the accepted theory of water-wheels, the experimental researches of Smeaton, and the recent improvements in theory, due to the analytic investigations of German and French Engineers.

Smeaton, in his Paper on Water-wheels, read to the Royal Society in May, 1759; and Dr. Robison, in his Treatise on Water-wheels, lay down as a fixed principle, that no advantage can be obtained by making the diameter of an overshot-wheel greater than that of the total descent, minus so much as is requisite to give the water, on reaching the wheel, its proper velocity.

The author, however, contends that while the reasoning of the latter is inconclusive, there are some circumstances which are necessarily in favour of the larger wheel, and that conditions may occur in practice, in which it is desirable to use the larger wheel, even at some sacrifice of power; and that hence it is important to ascertain its co-efficient of labouring force, as compared with that of the size assigned by Smeaton for maximum effect.

The author states, first, the general proposition, that the labouring force ("travail" of French writers), or "mechanical power" of Smeaton, of any machine for transferring the motive power of water "is equal to that of the whole moving power employed—minus the half of the *vis viva* lost by the water on entering the machine, and minus the half of the *vis viva* due to the velocity of the water on quitting it." He deduces from the theory, the following results, coinciding with the conclusions obtained by experiment.

1st. If the portion of the total descent passed through by the water before it reaches the wheel, be given, the velocity of the circumference should be one-half that due to this height.

2nd. If the velocity of the circumference be given, the water must descend through such a fraction of the whole fall before reaching the wheel, as will generate the above velocity.

3rd. The maximum of labouring force is greater, as the velocity of the wheel is less; and its limit theoretically approaches that due to the whole fall.

General equations are given, expressing the amount of labouring force in all the conditions considered, and their maxima.

One of the principal advantages of using an overshot wheel greater in diameter than the height of the fall, is the power thus afforded, of rendering available any additional head of water occurring at intervals, from freshes or other causes, by admitting the water upon the wheel at higher levels.

The first course of experiments is dedicated to the determination of the comparative value of two water-wheels, one of whose diameter is equal to the whole fall, and the other to the head and fall, or to the total descent; by the head, being in every case understood the efficient head, or that, due to the real velocity of efflux at the shuttle, as determined according to Smeaton's mode of experimenting.

The apparatus employed in this research consisted of two accurately-made models of overshot wheels, with curved buckets; these were made of tin plate, the arms being of brass and the axles of cast-iron. Special contrivances were adopted to measure the weight of water which passed through either wheel during each experiment, to preserve the head of water strictly constant, and to determine the number of revolutions and the speed of the wheels.

One wheel was 25·5 inches diameter, the other, 33 inches diameter. The value of the labouring force was determined directly, by the elevation of known weights to a height, by a silken cord over a pulley; the altitude being read off, on a fixed rule placed vertically against a lofty chimney; and in other experiments, relatively by the speed of rotation given to a regulating fly or vane. The depth of the efficient head was in all cases 6 inches.

The weight of water passed through either wheel, in one experiment, was always 1,000 pounds avoirdupoise.

All the principal results given in the tables accompanying the paper are the average of five good experiments. From the large scale upon which these were conducted, the accurate construction of the apparatus, and the care bestowed upon the research, which was undertaken with reference to an actual case in the author's professional practice, he is disposed to give much confidence to the results.

The weight of water contained in the loaded arc of each wheel is accurately ascertained; and in the tables which accompany the paper, the results of the several experiments are given at length.

The velocity of the wheels, under different circumstances, is carefully noted and discussed with respect to the maximum force.

The author next ascertains the value of the circular conduits, and states that generally, in round numbers, there is an economy of labouring force, amounting to from 8 to 11 per cent of the power of the fall, obtained by the use of a conduit to retain the water in the lower part of the buckets of an overshot wheel, whose diameter is equal to the fall. The velocity of a water-wheel working thus may vary through a larger range, without a mate-

rial loss of power, and a steady motion is continued to a lower velocity than when it is working in a free race.

The author finally arrives at the following general practical conclusions:—

1st. When the depth of water in the reservoir is invariable, the diameter of the water-wheel should never be greater than the entire height of the fall, less so much of it as may be requisite to give the water a proper velocity on entering the buckets.

2nd. Where the depth of water in the reservoir varies considerably and unavoidably, an advantage may be obtained by applying a larger wheel, dependant upon the extent of fluctuation and ratio in time that the water is at its highest and lowest levels during a given prolonged period; if this be a ratio of equality in time, there will be no advantage; and hence, in practice, the cases will be rare when any advantage will be obtained by the use of an overshot wheel, greater in diameter than the height of fall, minus the head due to the required velocity of the water reaching the wheel.

3rd. If the level of the water in the reservoir never fall below the mean depth of the reservoir, when at the highest and lowest, and the average depth be between an eighth and a tenth of the height of the fall, then the average labouring force of the large wheel will be greater than that of the small one; and it will, of course, retain its increased advantage at periods of increased depth of the reservoir.

Dr. Robison's views, therefore, upon this branch of the subject, should, he contends, receive a limitation.

A positive advantage is obtained by the use of the conduit, varing with the conditions of the wheel and fall, of nearly 11 per cent. of the total power.

The value increases with the wheel's velocity, up to 4½ feet per second, or to 6 feet per second in large wheels. Hence, he argues that it is practicable to increase the efficiency of the best overshot wheels, as now usually made, at least 10 per cent. by this application. The only objections urged against the use of the conduit are of a practical character, relating to the difficulty of making it fit close, of repair, &c.; but however these may have applied to the rude workmanship of the older wooden wheels, with wood or stone conduits, they are unimportant, as referring to modern water-wheels made of iron. The conduits may be also made of cast-iron, provided with adjusting screws, and are hence capable of being always kept fitting, readily repaired, and of being withdrawn from the circumference of the wheel in time of frost, &c.

The paper is illustrated by a drawing, giving the elevation and partial sections of the experimental apparatus, and by a diagram, showing the full size of the loaded arc of each model.

Mr. Farey observed, that the result arrived at by the experiments appeared to correspond nearly with those recorded by Smeaton, who had experimented upon, and used practically both kinds of wheels. The buckets of the model wheels used in the experiments did not appear to be of the best form, and they were entirely filled with water; hence, an apparent advantage had been obtained by the use of the circular conduit to retain the water in the buckets. But that would not be realized in practice; for, as the form of the bucket regulated the point at which the water quitted it, and it was the practice of the modern mill-wrights to make the wheels very broad, in order that the buckets should not be filled to more than one-third of their depth, the circular conduits became less useful, and in fact were now seldom used. Smeaton's practice was to entirely fill the buckets with water, but he never adhered to the slow velocity of revolution which he recommended theoretically, in his paper to the Royal Society.

Mr. Fairbairn had adopted broad wheels with an improved form of bucket partially filled, and had obtained a more regular motion, particularly at high velocities.

Mr. Farey promised to present to the Institution a copy of the method of calculation adopted by Smeaton for water-wheels.

Mr. Taylor corroborated Mr. Farey's statement of the advantage of using broad wheels, with the buckets of a fine pitch, and partially filled; circular conduits then became unnecessary: this was practised among the millwrights in North Wales with eminent success, and a velocity of 6 feet per second was given to the wheel.

Mr. Homersham believed that in Smeaton's latter works he increased the velocity of his wheels to 6 feet per second.

Mr. Rennie gave great credit to the author for the ingenuity of the apparatus with which the experiments were tried, and for the clearness of the tabulated results; but, owing to the necessary limited size of the model wheels, he feared the results could not be relied upon for application in practice to large wheels. The experiments of Borda, Bossut, Smeaton, Banks, and others, were all liable to the same objection.

The best modern experiments were those by the Franklin Institute, by Poncelet, and by Morin.

The result of these might be taken thus:—

Undershot wheels, the ratio of power to effect, varied from			0·27 to 0·30
Breast wheels	,,	,,	0·45 to 0·50
Overshot wheels	,,	,,	0·60 to 0·80
Average ,,	,,	,,	0·60

The velocity of the old English water-wheels was generally about 3 feet per second; and the American wheels 4 feet, and the French wheels 6 feet: this latter speed was now adopted by the best mill-wrights in England. Mr. Hughes, (at Mr. Gott's factory at Leeds,) and Mr. Fairbairn, had found advantage from it; the latter also had a particular contrivance for carrying off the air freely from the buckets.

It was important to regulate the thickness of the sheet of water running over the shuttle upon the wheel. The best maximum depth was found, in practice, to be from 4 to 5 inches.

The object being to utilize the greatest height of fall and the greatest available quantity of water, by means of properly constructed openings and such sluice-gates as were first introduced by the late Mr. Rennie for the breast-wheels constructed by him, instead of penning up the water in a trough, it was made to flow in a sheet of regular thickness over the top of the shuttle, and by a self-regulating apparatus to adjust itself at all times to the height of the water. Thus obtaining the advantage of the full height of the fall at its surface, and obviating the necessity for the apparatus proposed by Mr. Mallet.

Mr. Mallet begged to dissent from the validity of the objections which had been made to the practical value of his experiments. With respect to the form of the bucket; that used by him, could not, he contended, be called a bad form, although it might be susceptible of improvement; but as the experiments were altogether comparative, it was foreign to the question whether the form was bad or good, the same having been used in both wheels.

As it was shown that a certain relation subsisted between two water-wheels with the same total descent, but with different diameters, as to their co-efficient of labouring force, a proportional relation would exist with any worse or better form of bucket. The results, considered as absolute measures of effect, being obtained with a form of bucket, which approached nearer to the best forms now in use, than did those of Smeaton or any other experimenter, were more applicable to modern practice, and therefore he must consider his results, as not without utility.

With regard to the custom of only partially filling the buckets, it must be remarked, that buckets of the best forms begin to spill their contents before arriving at the lowest point of the loaded arc; the partial filling could therefore only palliate the evil which the circular conduit was designed to remedy. He must, however, argue that a positive disadvantage attends the partial filling. A permanent loss of fall was produced, equal to the distance between the centres of gravity of the fall, and of the empty portion of the top bucket, at the moment it had passed the sluice; the distance could be but little varied by the fineness of pitch of the bucket, and depended more upon the depth of the shrouding. That there was a constant loss of labouring force, by practical diminution of the effective leverage or a reduction in the "moment" of the loaded arc; that as the wheel revolved, the centre of gravity of the fluid contained in each bucket, as it approached the lower portion of the loaded arc, was transferred to a greater distance from the centre of motion even before the contents commenced spilling; but the angular motion, of the centre of gravity of any one bucket, was at first, that due to its distance from the centre of motion of the wheel, or to its radius; and as the radius increased, a greater angular velocity would be acquired by the water which had changed its position on approaching the lower point of the wheel, but this increased velocity was given at the expense of the power of the wheel, and hence a partially filled bucket would, he believed, be always attended with a loss of labouring force. To the last objection, a full bucket was not liable.

From these reasons, he felt justified in concluding, that the use of the circular conduit was more advantageous than the practice of partially filling the buckets.

With respect to the shuttle delivering the water over the top; where the head of water and the fall were constant, no advantage could be obtained by the use of a wheel greater in diameter than the total descent; It was assumed that this form of shuttle would be used, in order always to deliver the water as high as possible upon the periphery of the wheel; but the question was, "If the head be variable, what should be the diameter of the wheel to secure the best effect?" The paper showed that a wheel whose diameter was equal to the total descent, when the head was a maximum, did not always give the greatest average labouring force. The question was therefore independent of the sort of shuttle used; it assumed the power of always admitting the water upon the wheel at the highest point of the total descent, and sought to establish the best relation between the diameter of the wheel and the whole descent, when the head alone was variable, according to given conditions. The results of this part of the investigation, therefore, while they admitted the full value of Mr. Rennie's shuttle, went further, and pointed out the limits of its useful application.

He was fully aware of the prejudice which existed against the circular conduit, and he once participated in it; but his attention

had been forcibly drawn to it in his professional practice, and having used it very beneficially upon wheels of 40, 50, and 60 horses' power which he had constructed for mining purposes, he wished to draw the attention of engineers to the consideration of its practical merits when adapted to good wheels.

SYNOVIA OIL.

Sir,—The attention of the most eminent English, as well as French chemists has been engaged, for some considerable period, in endeavouring to discover the best and most efficacious means of purifying common fish and other oils, (by depriving them of a portion of their mucilaginous and gelatinous matters,) and rendering them equal to sperm; and although aided by the application of peculiar-shaped glasses, and various descriptions of lamps, they have not hitherto been enabled to produce an oil (giving a pure and brilliant light) free from carbonization of the wick, corrosion of the lamp, and the necessity of repeated cleaning.

The attempts to obviate these evils having proved unsuccessful has induced me to devote a great portion of time, labour, and attention to accomplish this desirable object; and I flatter myself, after elaborate experiments upon different oils and unctuous matters, and careful research as to their ultimate analysis, I have discovered an oil that will be found, for lubricating machinery and illuminating purposes, equal, if not superior, to the best sperm. The results of this discovery I now respectfully submit to the scientific and the public generally.

Chemically considered, it contains no salt or free acid, and is perfectly divested of all unpleasant smell, taste, or mucilage; it produces a clear, steady, and brilliant white flame, equal to gas; will in no instance corrode brass, or other metal used in machinery, or lamps, of whatever metal manufactured; does not carbonize the wick; requires no snuffing or turning up; and will burn in any lamp. The lamp so used need only be cleaned out once in six months.

The application of this oil to stationary and marine engines, as well as locomotives, and machinery in general, has been most satisfactorily tested: its non-corrosive and durable qualities render it superior to oils ordinarily used, it being generally admitted that they, by frequent application, become so adhesive, that the parts require scraping, the machinery becomes deranged, with considerable increase of friction, thereby causing many serious accidents. By the use of this oil, engineers will find the additional trouble and danger to be entirely superseded.

For manufacturers of woollen cloths, cotton dyers, and worsted spinners, it is invaluable; possessing advantages over every other oil now in use, not the least affecting the colour of white wool, and may be safely introduced in every process where more expensive oils at present only can be used.

Chemists, perfumers, and others, will find this an economical substitute for every purpose where the purest and best vegetable oils are required. The price, per tun of 252 imperial gallons, is 69*l.* 6*s.*, or 5*s.* 6*d.* per gallon. I am, Sir,

Your most obedient servant,

A. L. HARRIS.

30, Steward-street, Bishopsgate.

[A specimen of this oil has been sent us along with the preceding communication, and, as far as we can judge of it from inspection and a few brief trials, it fully answers the description given of it by Mr. Harris. It is not, we understand, a purified fish oil, but an entirely new animal oil.—Ed. M. M.]

NOTES AND NOTICES.

"*The Learned Attorney General*"—At the last Meeting of the Royal Society a paper was read "On a Method of proving the three leading properties of the Ellipse and Hyperbola," by Sir Frederick Pollock. The method, though founded on a well known property of the circle, is described to us by a very competent judge, as distinguished by perfect originality, and demonstrated with great clearness and eloquence. That a good lawyer should also be a good mathematician is nothing surprising (for where should a First *Wrangler* succeed if not at the Bar?); but that a gentleman at the head of his profession, and holding a public office of the first importance, should, amid the multifarious, arduous, and harassing duties which he has to discharge, and discharges so well as Sir Frederick Pollock does, be able to snatch a leisure hour to contribute to the Philosophical Transactions of his country, and inclination so to employ it, is surprising, if not indeed without a precedent in the history of Attorney Generals.

Street-sweeping by Machinery.—The first exhibition, in the metropolis, of the self-loading cart, or street-sweeping machine, which has for some time been in use in Manchester, and is fully described in *Mech. Mag.*, No. 1014, took place recently on the wood-pavement in Regent-street, and attracted crowds of persons to view its very novel apparatus. The cart was drawn by two horses, and attended by a driver, and as it proceeded caused the rotatory motion of the wheels to raise the loose soil from the surface of the wood and deposit it in a vehicle attached to the cart. Proceeding at a moderate rate through Regent-street, the cart left behind it a well-swept track, which formed a striking contrast with the adjacent ground. It filled itself in the space of six minutes, its power being equal to that of forty men, and its operation being of a three-fold nature—that of sweeping, loading, and carrying at the same time, which, under the old process, formed three distinct operations.

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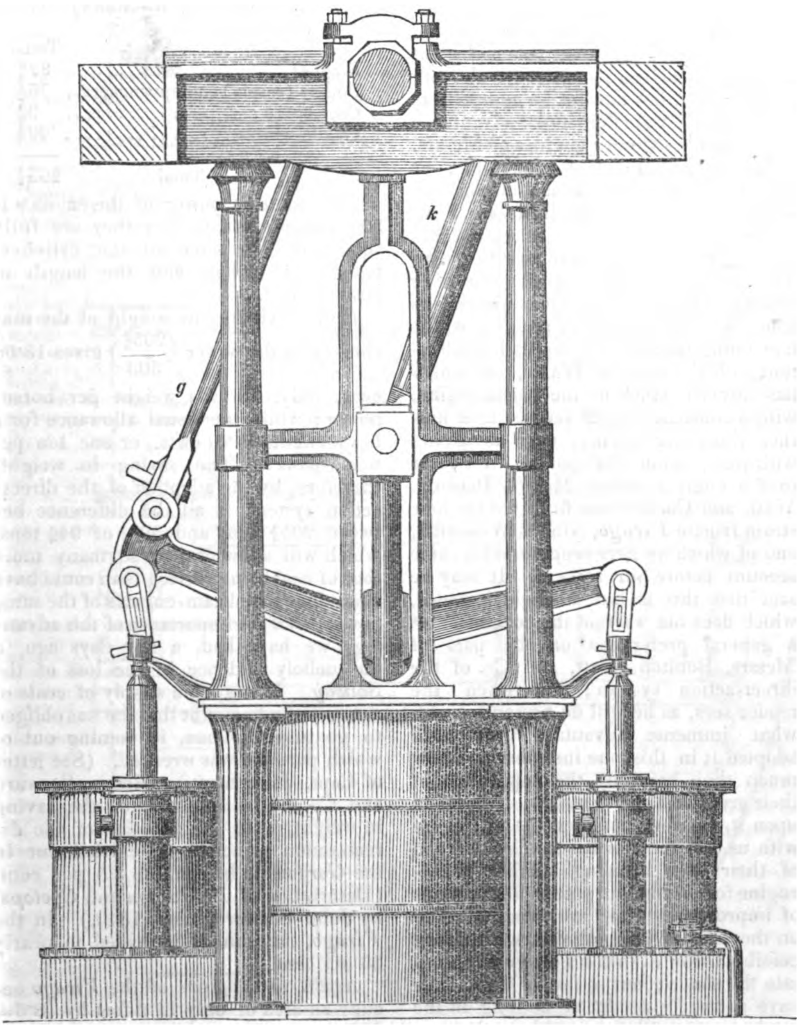
THE STEAM-ENGINES OF H. M. STEAM FRIGATE "VIRAGO."

[MANUFACTURED BY MESSRS. BOULTON, WATT, AND CO.]

Fig. 1.



THE STEAM-ENGINES OF H. M. STEAM FRIGATE "VIRAGO."

The superiority of direct-acting engines over beam-engines for marine purposes seems to be now all but universally acknowledged. Since Messrs. Seaward and Co. first led the way in this system of construction, in the *Gorgon* and *Cyclops*, (for though there may have been a preceding attempt or two to introduce the direct-action principle, it is not to be denied that the current of public opinion had continued till then to run altogether in favour of beam-engines,) it has been steadily gaining ground, till it has at length quite driven its ancient rivals from the field, and has now for its competitors such plans only as offer similar advantages —the double cylinder engines of Messrs. Maudslay and Field, for example, or (for vessels not of great magnitude) the oscillating engine, of which Messrs. Penn and Son have produced so many admirable specimens. We have now to record what may be regarded as the crowning triumph of the direct-action system, its adoption by the engineering firm which has immortalized itself by its identification with the name of WATT, and which has hitherto stuck to the beam-engine, with a constancy which seemed as if neither time, nor science, ever advancing with time, could change it. We refer to the engines which Messrs. Boulton, Watt, and Co. are now fitting to the new steam frigate *Virago*, lying at Woolwich, and of which we here propose to lay some account before our readers. It may be said that this is but a single instance, which does not warrant the conclusion of a general preference on the part of Messrs. Boulton, Watt, and Co. of the direct-action system; but when the reader sees, as he will do presently, with what immense advantage they have adopted it in this one instance, and how much they have, by the application of their great skill and experience, improved upon it, we feel confident he will agree with us that there is but small likelihood of their ever building another beam-engine for marine purposes. Other plans of improvement they are reported to be on the eve of bringing out, which may possibly throw even the *Virago's* engines into the shade; but so far, at least, they [illegible] produced nothing in the [illegible] to them.

[illegible] tons [illegible] burthen, and of the following dimensions:—

	ft.	in.
Length between perpendiculars	180	0
Do. keel	106	0
Extreme breadth	36	0
Tonnage breadth	35	8
Moulded do.	35	0
Depth in hold................	21	0

The weights of the different parts of the steam propelling machinery are as follows:—

	Tons.
Engines....................	89¾
Boilers (empty) and appendages..	76¼
Coal-boxes..................	9¾
Paddle-wheels	29½
Total........	205¼

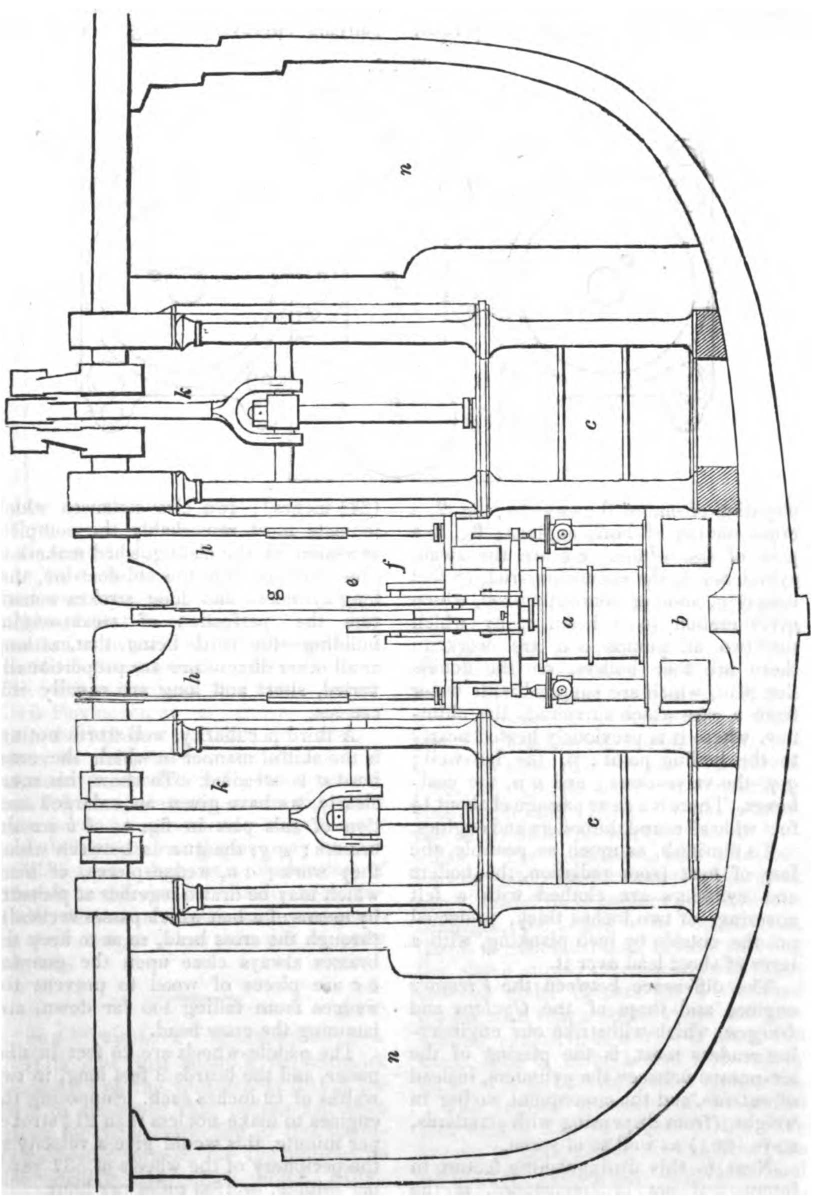
The contract power of the engines is 300 horses; and to this they are fully equal, the diameter of the cylinders being 64¾ inches, and the length of stroke 5 feet.

Now, dividing the weight of the machinery by the power $\left(\frac{205\frac{1}{4}}{300}\right)$ gives 13·68 cwts. only, for the weight per horse-power; while the usual allowance for a beam-engine is 20 cwts., or one ton per horse-power. The saving in weight, therefore, by the adoption of the direct-action system, is all the difference between 205¼ tons and 300, or 94¾ tons, which will allow of just so many more tons of coal being carried than could have been done with beam-engines of the same power. Of the importance of this advantage we have had, a few days ago, a melancholy evidence in the loss of the *Solway*. It was for a supply of coals of not quite that amount that she was obliged to go into Corunna, in coming out of which port she was wrecked. (See letter of Capt. John Scott.) Messrs. Seaward and Co. originally estimated the saving in weight, from the adoption of the direct-action principle, as carried out in the *Gorgon*, to be equal to 25 per cent. (Description of the *Gorgon* and *Cyclops*, by John Seaward, Esq., 1840.) In the *Virago*, the gain is increased to nearly 33 per cent.

Again, the engines of the *Virago* occupy an area of only 12·2 feet by 18·6 = 237 square feet, while a pair of beam engines of the same power, and of

Messrs. Boulton, Watt and Co.'s best make, would have required an area of at least 414 square feet (23 × 18); being a saving in room of nearly one half.

Fig. 2.

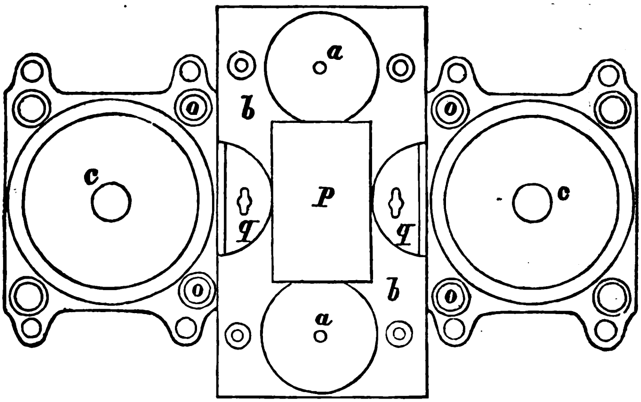


The coal-boxes of the *Virago* are of capacity enough to hold 350 tons of coal, which is sufficient for 14 days' steaming, at the rate of 8 lbs. per horse power

per hour, supposing the engines to be incessantly going. With all this weight added, the boilers filled, (equal to 41 tons more,) and three months' stores on board, the load-line of the *Virago* is only 13 ft. 3 in., and her midship sectional area about 385 feet.

The structural arrangements of the machinery are exhibited in the accompanying engravings. Fig. 1 is a side

Fig. 3.



elevation of one of the engines; fig. 2, a cross section of both engines; fig. 3, a plan of the whole. *c c* are the steam cylinders; *k*, the connecting-rod, (8 feet long;) *g*, another connecting-rod, which gives motion to a beam *e*, by which the two air-pumps *a a* are worked; there are four boilers, on the double flue plan, which are supplied with water from a case which surrounds the chimney, where it is previously heated nearly to the boiling point; *p*, the hot-well; *q q*, the valve-cases; and *n n*, the coal-boxes. There is a clear passage of about 1½ foot wide all round the boilers and engines.

To diminish, as much as possible, the loss of heat from radiation, the boilers and cylinders are clothed with a felt covering, of two inches thick, protected on the outside by inch planking, with a layer of sheet lead over it.

The difference between the *Virago's* engines and those of the *Cyclops* and *Gorgon*, which will strike our engineering readers most, is the placing of the air-pumps *between* the cylinders, instead of *outside*, and the consequent saving in weight, (from dispensing with standards, stays, &c.,) as well as of space.

Next to this distinguishing feature in interest, if not in importance, is the shortness of the stroke (5 feet), and the close assimilation of the length of that stroke to the diameter of the cylinders (64¾ inches); two circumstances which indicate most remarkably the complete secession of the distinguished makers of these engines from the old doctrine, that long cylinders and long strokes constitute the perfection of steam-engine building—the truth being, that, as long as all other dimensions are proportionally varied, short and long are equally efficacious.

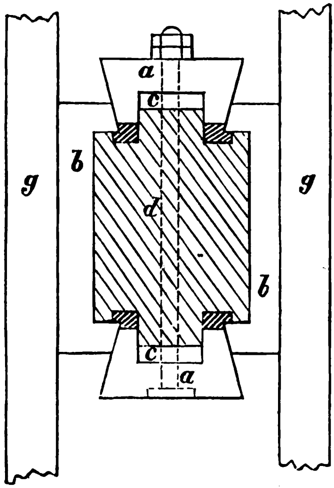
A third peculiarity, well worth noting, is the skilful manner in which the cross head *d* is steadied. To show this more clearly, we have given an enlarged section of this part in fig. 4. *b b* are the brasses; *g g*, the guards between which they work; *a a*, wedge-pieces, of iron, which may be drawn together at pleasure by means of a bolt which passes vertically through the cross head, so as to keep the brasses always close upon the guards; *c c* are pieces of wood to prevent the wedges from falling too far down, and jamming the cross head.

The paddle-wheels are 25 feet in diameter, and the boards 8 feet long, in two widths of 12 inches each. Supposing the engines to make not less than 21½ strokes per minute, this would give a velocity to the periphery of the wheels of 537 yards per minute, or 18·3 miles per hour.

We need scarcely add, that the direct-action system has other recognized advantages besides those before adverted

to; such as the diminution of vibration, from absence of the beam and side levers

Fig. 4.



—the lessening of the chances of accident, from the lessening of the number of these working parts, by the failure of which accidents may be occasioned, &c. The question as to the difference in point of friction between beam and direct engines has been revived at the Institution of Civil Engineers, as our readers will see from the Minutes of their Proceedings, given in our present Number, but with not much practical benefit. The necessary data for calculating the actual difference have yet to be ascertained; but, if mere probabilities and analogies may be depended upon, there is a diminution of friction in the case of direct-action engines, very nearly in the same proportion as their weight is less than that of beam engines.

THE "PENELOPE" STEAM-FRIGATE.

It is now just about a twelvemonth since we had the pleasure of being the first to announce that orders had been given for the construction of this steam-frigate—the largest, for the present, in the British navy—(see *Mech. Mag.*, April 9, 1842,) and already she is on the point of completion! The entire vessel, it is true, had not to be built, for, in order to meet the then exigent state of our affairs in China and India, the expedient was had recourse to of cutting one of the largest and newest of our frigates in two, and inserting fifty-five feet additional amidships; but, to have accomplished even so much, and completed, besides, the whole of the steam machinery, within so short a period, says a vast deal for the ability, energy, and assiduity of all concerned. We feel confident that in no other country in the world could the like have been done. The vessel having been remodelled at Chatham Dock-yard, under the superintendence of Mr. Edye, Assistant-Surveyor of the Navy, by whom she was planned, was towed up the river, a week or two ago, to the wharf of Messrs. Seaward and Co., to be there fitted with the machinery, which they had in readiness for her. The engines, which are on the *Gorgon* direct-action plan, and executed in the first style of workmanship, are of the nominal amount of 650 horses' power, but are considered to be capable of being worked up to 800. The cylinders are 92 inches in diameter, and the length of stroke also 92 inches. The steam is to be worked expansively, by means of the well-known slide-valves invented by the late Mr. Samuel Seaward, and adopted in most of the vessels fitted by this firm. The boilers are four in number, with double flues, and only 9 ft over all. A condensing apparatus, on Mr. Samuel Hall's plan, has been added, which, though consisting of some twenty miles and more of tubes, has been packed into a wonderfully small space, and so placed as not to interfere at all with the working of the engines. The coal-boxes will hold 600 tons of fuel. Notwithstanding the great magnitude of these engines and their appendages, the vessel is so commodious, that it is calculated that, besides carrying the above supply of coal, she will have stowage under hatches for a thousand troops, with four months' stores and provisions, exclusive of a crew of about 450 men. She is to be armed with twenty guns, of large calibre, besides carronades.

The engines are stated to be of 220 tons weight, and the boilers of 95. We are not in possession of the weights of the coal-boxes, condensing apparatus, and paddle-wheels; but suppose we add, on that account, 100 tons, which is, probably, not far from the truth, that would raise the total weight to only 415 tons,

being equal to about 13 cwts. per horse power. From this it will be seen that Messrs. Seaward and Co. have, as well as Messrs. Boulton, Watt, and Co., made a great advance in the saving of weight, since the construction of the *Gorgon* engines, which were estimated to be of 15 cwts. per horse power.

When the vessel is out of the engineers' hands, we hope to have an opportunity of obtaining some further particulars, with respect both to her build and machinery.

PROGRESS OF SCREW PROPELLING.

In our review of Mr. Elijah Galloway's Appendix (D) to Tredgold, (*Mech. Mag.*, Aug. 20, 1842,) we noticed some experiments which had been then just made in Long Reach with Smith's Archimedean propeller, on board the *Bee*, a small Government steamer, of 30 tons burthen, and 18 horse-power. The result of these experiments was more unfavourable to the screw than any which had been previously published; the average speed attained having been only 7·358 miles, while the average performance of the *Archimedes* steamer, when under Captain Chappel's direction, was about 8¼ miles. Since that time, Mr. Blaxland's propeller, and also Captain Ericsson's, have been successively fitted to the same vessel, and similar trials of them made in Long Reach (over the measured mile). Three trials (each trial being once up and once down) with Blaxland's propeller, worked by bands, gave an average speed of 7·1152 miles per hour. The like number of trials with Ericsson's gave only 5·486 miles; though, in actual practice, this propeller is stated in the American papers to be now daily realising 8, 9, and 10 miles an hour.

All these screwing performances have been, however, greatly exceeded in a private steamer called the *Mermaid*, fitted with the conoidal propeller of Mr. George Rennie (of which a full description is given in our 879th Number), and worked through the medium of toothed wheels. The vessel is of iron; of about 230 tons burthen, and 90 horse-power; 140 feet long, and 16 feet 6 inches beam. On the 28th ult., she started from Deptford, and, though steaming against wind and tide, reached Erith pier in one hour, which, according to Captain Bullock's Admiralty map, is a distance of 12¼ miles. If we estimate the counteracting influence of the wind and tide as being equal to only 1¾ miles (a very moderate allowance), that would raise the efficiency of Mr. Rennie's propeller to full 14 miles an hour. No such rate of speed as this has ever before been obtained by means of the screw, and if future trials should correspond with the present, then may we truly say, the days of the paddle-wheel system are numbered.

The Lords of the Admiralty, it may be remembered, ordered two frigates to be built, *of the same lines and steam power*, one to be fitted with paddle-wheels of the most approved construction, and the other with a screw-propeller on Mr. Smith's plan, in order that the comparative merits of the two systems might be finally tested under exactly similar circumstances. Both of these vessels (the *Polyphemus* and *Rattler*) have now been launched—the last a few days ago; and we may now, therefore, soon expect to hear something of their respective capabilities. As we stated before, however, (20th August, 1842,) we do not think this mode of testing the two systems by any means so good as that followed in the *Bee;* since nothing is more notorious than that the same lines and weights do not always in sea affairs produce identical results; and should Mr. Smith's propeller perform better now than it did then, we shall be inclined to attribute the circumstance to an avoidance of those defects in construction, to which Mr. Smith ascribed the indifferent performances of the *Bee*.

Captain Beechey, in his lately published "Voyage of Discovery towards the North Pole," points out a very valuable application which might be made of the screw, in future arctic expeditions.

"The openings in the ice are generally of short duration, perhaps for eight or twelve hours only, during which time an ordinary sailing vessel, threading the many tortuous channels, does not advance above ten or twenty miles in a direct line before the closing of the fields puts a stop to her progress; whereas a steamer, regardless of wind—and it is in calm weather mostly that the ice opens—would be able to accomplish three or four times the advance in the same period; and, perhaps, to come to some land in

the north, which if reached, would materially improve her prospect of success. In the event of the ice closing, the propeller could be instantly drawn up into the body of the vessel, and when wanted could be as expeditiously replaced, especially as smooth water generally prevails between the floes of ice. In case of frost, the screw is wholly under water, and entirely free from that accumulation of ice, which would take place about the paddle floats and boxes of an ordinary steam-vessel, to the great detriment, if not the entire destruction, of the wheel. Should the vessel be caught, and compelled to winter, a steam apparatus for warming the vessel throughout could be fitted with little trouble. And as the propeller is only intended to be used as an auxiliary power, a small high-pressure engine would be all that would be required, and consequently it would take up but little of the stowage of the vessel. In short, it seems as if this invention had appeared about this time to stimulate us to further exertion, and the auspicious return of Captain James Ross from the Antarctic seas, with officers and seamen already accustomed to the ice, and with two vessels ready strengthened, to which the propellers could be applied at a moderate expense, appears to mark the present as a period at which arctic research might be advantageously resumed."

ON THE OBJECTIONS TO MR. HENSON'S PLAN OF AERIAL TRANSIT. BY L. L.

(Concluded from p. 318.)

I formerly noticed the dearth of needful experiments, and utter absence of sufficient theory on this subject. It is probable, however, that the experiments mentioned by Sir George Cayley would supply some important data. It has not been my good fortune to meet with any account of them, and perhaps they are not published.

Does it follow, that, because a crow, stationary in the air, with outstretched wings, would acquire, in falling through the air, a maximum velocity of 21 feet per second, that he must lift himself with his wings at that rate? Suppose the beats be made at the rate of two in a second, at the end of the first half second, the velocity acquired is less than the half of 21 feet; it is destroyed, and the original position regained by the first stroke of the wings. The next, and every succeeding half-second, is but a repetition of the first. Perhaps enough is said to show that this principle of calculation needs to be revised.

It is suggested that, if the wings of Mr. Henson's machine were inclined to each other, like a V, the stability of the whole would be increased. It will, however, be observed, that, as at present constructed, the centre of gravity is at some distance below the wings, sufficiently so, perhaps, to ensure the necessary steadiness, and that too stable a machine, that is, one which would yield but little to the blow of a gust on one end, would be in danger of being broken by the blow: it may be, on the whole, safer if it suffer itself to be rocked to some extent by such an impulse, provided the effect of the weight below the planes is sufficient to ensure its gradual return to a steady horizontal position. It is probable that this is one of the points which only experience can determine.

Of perhaps more obvious utility and more probable adoption is the plan of dividing each wing into two or more portions and placing them over each other. The danger here, I conceive, is that the air between the "decks" would not act with the same effect as if it were not so confined. Here again, we have no certain facts for guidance.

Sir George seems to conclude, that Mr. Henson's speed will be limited to that of the crow, or thereabouts, and I believe Mr. H. himself has made no great professions on this point. But it should be remembered, that a high speed will require but little more power than a lower one for its maintenance, if that high speed be communicated at starting by the inclined plane, or stationary engine. Connected with this subject are some conclusions of great importance, of which I can now mention only one. If a carriage on Mr. Henson's plan, with its wings at a certain angle with the horizon should be driven by greater power than is necessary just to maintain its speed, the whole machine will rise: to prevent that rise, the wings must be placed at a smaller angle, and at that smaller angle they meet with less forward resistance. The superabundant power must be spent in elevation or in speed: and the power and angle are so coupled together, as that to diminish one, requires an increase of the other, if the uniformity of the speed is to be preserved: and if the whole or any given part of the embarked power is to be employed, it may as well be spent on a high speed

as a low one. All this, however, supposes the common theory of oblique resistance to be true, or at least, in this respect, to have the same consequences as the true one: and it supposes also, that we have to deal only with the wings, and not with the resistance of the air to the car, &c., &c. I adduce these consequences, subject as they are to reservations so large, merely for the sake of showing that it is not certain, or even probable, that the machine, if successful at all, will be limited in use to low speeds.

In common with many others, Sir George fears that the wings are much too large to be made strong enough, and compares them with those of birds. Perhaps it is enough on this subject to say, that we build locomotives and ships much larger and stronger than horses and whales, and may therefore conclude with some likelihood, that in flying machines we may not have to stop at nature's limit of size and strength.

Navigable balloons seem to be liable to two objections, besides those which have been commonly noticed. The first, is, that in passing with any useful rapidity through the air, their shape would be greatly altered by the pressure in front, and, therefore, the amount of resistance would vary greatly from that which might be anticipated from the original conformation. The other, and perhaps more formidable difficulty is the following:—if the propelling apparatus be entirely in the car, that appendage would be dragged considerably out of the perpendicular before the balloon would move with it, as will appear on consideration of the forces which must act in the case. I cannot see how this evil is to be obviated, but by mounting part of the propelling apparatus on the top of the balloon, or in some other way, so disposing of the parts which actually strike the air, as that the resultant of their pressures shall correspond in position with that of the pneumatic resistance. At present there seems little hope that this mode of aerial transit will be rendered available; but the registering and discussion of its principles, will either bring it into working condition, or at least tend to save us from loss and disappointment, which might for a long time discourage all attempts to accomplish the same object, however different might be the means.

This paper, already too long, I must now bring to a close; and in doing so, I cannot but express my anxiety, that the art of aerial locomotion should soon be put into the possession of man, and my belief, that by whomsoever Providence may eventually send so great a gift, of all the plans for that purpose now before the public, Mr. Henson's is, on the whole, the most likely to succeed.

L. L.

FLYING MACHINES.

Sir,—We are not destitute of data for estimating the force which is called into action in order to sustain, and keep in motion in the air, bodies, more or less heavy; sufficient has at least been done to enable us to form some conjecture respecting the probability of the success of Mr. Henson's machine. An elaborate memoir on this subject by M. Chabrier, has been published by the Institute of France, in which will be found a profound mathematical inquiry into the conditions necessary for the movement of machines in the air. In Dr. Todd's Cyclopædia of Anatomy and Physiology, part 23, article Motion, I have contributed a number of illustrations, by ascertaining the weight of various insects, bats, and birds, and the amount of surface in each respectively. I have also computed the number of strokes made in a second by the wings of the rook and the pigeon during flight. It appears that the average weight of the pigeon is 4347·344 grains; that of the rook 4170·25 grains; and that of the canary 229 grains; whilst the areas of their wings are respectively, 0·6198, 1·11, and 0·054 of a square foot. Hence we see that the areas of the wings of birds do not vary as their weight; and that the rook has nearly half a pound weight to the square foot, and the pigeon one pound; the former making two, the latter, three effective strokes of the wings in a second. The weight of the former is therefore greater, that of the latter less, in proportion to the surface presented to the wind than in Mr. Henson's machine.

It must, however, be borne in mind that in this machine the surface presented to the wind has no motion like the wings of birds, neither does the machine possess the power of ascending vertically. In birds, on the contrary, according to

Borelli,* the power of the muscles which move the wings, compared with their weight, is more than 10,000 to 1; whilst their mass, compared with the muscles moving the legs is as 3 to 1. We agree with M. Chabrier, that the amount of force requisite for aerial progression is so enormous, owing to the rarity of the atmosphere, that it would be impossible for a man to sustain himself in the air by his muscular strength alone, in any manner in which he is capable of applying it. For example, it is calculated that a man can raise 13·25 lbs. avoirdupois to a height of 3·25 feet in a second, and that he can continue this exertion for eight hours in a day. In that space of time he will therefore exert a force capable of raising 381600 lbs. to a height of 3·25 feet, or 47700 lbs. to a height of 26 feet, which, according to M. Chabrier, is the height to which the swallow would raise itself in a second of time, by the force which it is obliged to exert in order to sustain itself in the air. Now, if we suppose the conditions necessary for flight in man to be the same as in birds; and that a man whose weight is 150 lbs., could concentrate the muscular power of a day's labour into as short a period as the accomplishment of the object required, the time t, during which he would be enabled to support himself in the air would be,

$$150\,t = 47700;$$

hence, $t = \dfrac{4770}{150} = 318''$, or about five minutes.

The surface of the wings in the rook and the pigeon when expanded, will not support them stationary in the air, unless they move with rapidity; for when the wings of the rook are expanded motionless in the air, the bird descends by its own gravity with considerable velocity; and as it has a greater surface, compared to its weight, than Mr. Henson's machine, it follows that the latter would be precipitated to the earth with still greater velocity, should the propelling apparatus get out of order in its transit through the air.

It appears by M. Chabrier's analysis, that the quantity of force expended to keep a body, whose weight is W, stationary in the air, (all other conditions being supposed the same), is as $\sqrt{W^3}$ directly, and $\sqrt{\text{density of the air}}$ inversely. I have, however, elsewhere shown that the quantity of force employed for this purpose by some birds is rather less than that here stated

I am, Sir, your obedient servant,

JOHN BISHOP.

London, April 15, 1843.

* De Motu Animalium.

MECHANICAL FLYING *v.* NAVIGABLE BALLOONS.

Sir,—Notwithstanding the tremendous "note of preparation" for an aerial trip to the antipodes, sober-minded philosophers persist in denouncing *mechanical flying* as a *mechanical impossibility!*

Perhaps few persons have studied this branch of science so thoroughly as your talented and respected correspondent, Sir George Cayley; and although he seems to admit that mechanical flying is of doubtful accomplishment, he is loth to give it up altogether.

I quite agree with him in opinion, that "balloon navigation is that designed for the use of mankind."

From pondering upon the principles originally laid down by Sir George Cayley, I was led to devise the navigable balloon, as announced in your pages and in several of the newspapers, nearly seven years ago, during which time it has been seen by several intelligent men, and by some of the first engineers of the day, who, however sceptical before, have, on inspection, one and all, declared that my plan is perfectly practical, and would, if brought out, "secure to this country the glory of being the first to establish the navigation of the terrestrial atmosphere."

My plan is still in abeyance, for I am getting somewhat tired of producing inventions for the gratuitous benefit of the million, and think it is now time that I should *begin* to reap some benefit for self. I must, therefore, be excused if I still withhold my long since perfected invention of a navigable balloon, until some more tangible benefit than the prospect of future immortality is forthcoming for my reward.

The concluding sentence of Sir George Cayley's last letter, (page 278,) is worthy the consideration of every patriotic philosopher. Let his appeal be answered, and I will prove that the "hour is come, and the man."

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington.
April 10, 1843.

ADVENTURES OF AN AERONAUT IN SEARCH OF A PATRON.

Sir,—I wish, with your kind permission, to place upon record, in your valuable "Museum" of remarkable inventions, that, if the world is not already in possession of the art of flying, it is the world's fault alone, or at least that of the world's rulers. Some ten years and more are past since, after much thinking and contriving, I invented a machine wherewith a man may fly about through the air, at all heights, and at all times and seasons, with (almost) the same ease as he can walk or run. I did fly with it, myself; though, from the necessity of keeping the thing a secret, it was within doors, and in a chamber of not large dimensions. I first wrote to our own government, informing them of the discovery I had made, and offering, on terms, to disclose it, for the benefit and glory of the country. After the (too) usual routine of rebuffs, contumely, and importunity, I at last succeeded, through the intervention of the member for the borough of which I am a native, in obtaining an interview on the subject with Lord Melbourne, at his seat of Brocket Hall. His lordship received me with great affability, and heard, with the greatest attention, all I had to say. He then asked if I had my machine with me? I said, no; it was safe at home, under lock and key. "But," said his lordship, smiling, "if you won't take off the *bushel measure*, how can we be sure there is the *light* under it?" I was about to explain, that I was willing to exhibit the invention to any committee of scientific gentlemen the government might appoint for the purpose, on condition that, if they reported in its favour, I should receive a suitable reward; but his lordship, quickly resuming the discourse, thus continued—"I'll tell you what I'll do for you, Sir: you shall come down here some day next week, and bring your machine with you; we shall start for town at the same time, you in your—*what 'ye call it*—and I in my pony phaeton, and if you reach Whitehall first, why then, Sir—*I'll mention the thing to the Queen!*" "No, no, my lord," I replied, "I have lived too long in the world, and lost already too much, by depending on public gratitude for the reward of former inventions of mine, to make my present discovery known on any such terms. But if your lordship will engage that, should I reach Whitehall before you, the government will pay me 50,000*l*. down, and 50,000*l*. more after any period that may suit their convenience—*that* I would leave to themselves—then, my lord, it shall be a match, and may come off any day you like!" His lordship said, he did not know but what I was in the right; but that he could not, consistently with his public duty, make me any such promise. Besides, he did not know that, if we could fly, there would be any public advantage in it; people, as it was, were but too much given to mad flights. In short, he saw he could not do any thing for me, and was very sorry, &c. &c. As I was then about making my bow, Lord Melbourne added, in a facetious tone, "You should see Brougham, however—he knows more about this sort of thing than I do." "I have seen Lord Brougham," I replied, "and it was he referred me to your lordship." "The deuce he did!" "Yes, my lord. 'You see Melbourne,' said he; 'yours is just the sort of thing he is in want of, to give him a *lift*—he will be delighted to see you.'" At this Lord Melbourne laughed heartily, and, ringing his bell, bade me "good morning."

Failing thus with the government of my own country, I applied to that of France, but had for my pains merely a polite acknowledgment of the receipt of my letter, and an intimation that "they would not give me any trouble on the subject." I then memorialized the Emperor Nicholas, and was waited upon by one of his agents in this country, who asked me how I proposed to prevent the smuggling of goods, and escape of deserters across the frontiers of a country? The learned sovereign of Bavaria,—that especial patron of all the arts and sciences—declined my offers, on the ground that his dominions were of too small extent to make flying of any consequence *to them;* but promised that, if I succeeded, he would give my bust a place in his Walhalla. ("He asked for bread, and they gave him a stone.") The courts of Berlin, the Hague, and Vienna were next successively applied to, but all with no better success. And now, Sir, here I am, after going the round of Europe to obtain patrons for an invention which is not any matter of speculation, but one of absolute certainty, and second to none, of all that ever were invented, in importance, as unpatronized and unbefriended as when I started. Is it not, Sir, a shame that such things should be?

I mean, in a few weeks, to pay brother Jonathan a visit, and see what he will say to it. Famous as he is for "going a-head," I have strong hopes that an invention which will enable him to "go aloft" as well, will be a little more favourably regarded by him than it has been by the dullards, (crowned and uncrowned,) of the old world. Could the young republic have any thing prouder to boast of—next to the achievement of its own independence—than that it

adopted as its own an invention which, though unequalled in grandeur and importance, was rejected by all the world beside?

Just let me add, before concluding, that I have attentively considered Mr. Henson's scheme, and can confidently affirm that it is a complete delusion. I am familiar, also, with every other scheme of the sort which has been yet made public, and with several that have been only privately exhibited; but the more I have seen, and the more I see, the more thoroughly I am satisfied, that, if flying is ever accomplished—or, as I ought rather to say, if it ever come into *general use*, for, as I have said before, *I have accomplished it*—it will be by the machine invented by, Sir,

Your most obedient servant,

RICHARD EVERETT CHARNOCK.

Thorn Cottage, Chiswick.
April 12, 1843.

PILBROW'S THEORY—IS THERE ANY POWER IN VELOCITY ALONE?

Sir,—I think you have acted with great (though perhaps pardonable) lenity, in 'letting off' your correspondent *Duplex* so easily. He verily and truly appears to believe in an innate power existing in motion—that is, that in a cannon ball in motion there is a self-born power of motion, begot from its velocity alone. Why should matter in motion beget a power which, when at rest, it cannot beget? It comes to the old question—Hath matter innate motion? Certainly not—under no condition whatever, whether in motion or at rest. It is the "*vis a tergo*"—the kick from behind—that projects matter, and when once projected, its motion is eternal, except from external causes, and when once at rest, its rest is eternal, except from external causes.

I recollect its being stated before some persons, not without considerable pretensions to education and learning, that a bullet from a gun, shot upright into the air and supposed to fall down in the same straight line, would have, in falling, inch for inch inversely the same force or power that it had in rising; that is, that at a given distance from the mouth of the gun (say two feet) the bullet had a certain force; then, at the same distance in falling down, it would have the same force. This demonstrable fact was denied—probably by the family of "Duplex."

Now, Mr. Editor, our friend "Duplex" having, in his opinion, abundance of proofs in support of Mr. Pilbrow's theory, rejects one (in his opinion again) crushing proof. He says, "not to *insist* on the analogy presented by falling bodies," &c. Not to insist, indeed! I think he *dare* not insist that there is any analogy. Pray ask him to prove that such exists, and your readers will be obliged. What! that falling bodies bring into existence a power from mere velocity alone! Your expression of the absurdity of the thing I accord with. Every schoolboy knows that the continually increasing velocity of a falling body is due to a power, continually increasing, acting externally on such falling body, and not from any innate self-generated action in the body, created from its mere velocity.

I am, &c.

J. M.

Battersea.

REGULATION OF THE SPEED OF THE PISTONS AND VALVES OF LOCOMOTIVE ENGINES.

Sir,—"Inventor," (No. 1019,) tells us that he can scarcely suppress a feeling of surprise that no *practically good* method has yet been adopted for diminishing the speed of the pistons and valves (of locomotive engines) without diminishing the speed of the engine itself;" and then recommends a trial of the sun-and-planet motion for that purpose. Without designing to call in question the utility of that ingenious and beautiful piece of mechanism, I beg to say that, during the course of last summer, I constructed a small model of a rotating appendage to the piston-rod, which will give any required number of revolutions to the driving-wheels, for each stroke of the piston, substituting for the varying force of the crank a power of uniform continuance. But whether mine may prove a "*practically good*" method, or not, is a question which a *practical* experiment on a working scale can alone determine. Nor can I pretend to say how soon such question will be resolved, having no practical knowledge of the arts necessary for its resolution.

I am, Sir,
Your most obedient servant,
JOHN CROWTHER.

Brosely, March 14, 1843.

INSTITUTION OF CIVIL ENGINEERS.
MINUTES OF PROCEEDINGS—SESSION, 1843.

February 7.

"*Description of a Drawbridge at Bowcombe Creek, near Kingsbridge, Devon.*" *By George Clarisse Dobson, Assoc. Inst. C. E.*

This drawbridge spans one of five openings in a stone bridge, built across a navigable branch of Salcombe Harbour; it is in one leaf, 15ft. 9in. wide, and 32ft. long,

from out to out, supported upon a cast-iron shaft or axle, placed 7ft. 6in. from the inner end, working in the abutment pier, which is built hollow to receive it, and thus the part within the axle-end acts as a counter weight.

To the centre of the end cross-beam of the counter part, a chain is attached, and after passing over cast-iron sheaves in the masonry of the face of the abutment, is coiled on a drum fixed on a horizontal shaft, carrying on one end a pinion, worked by a rack, attached to the piston of the hydraulic press; by this means, motion is given to the shaft and drum, and consequently to the leaf of the bridge. Balance-boxes are hung to the counter-end, by which the shutting is regulated. The struts for supporting the leaf, when raised, are also thrown in and out of their places by a rack and pinion.

The hydraulic press used for opening and closing the bridge, is simple in its construction, and the whole works so easily, that a female can open and close the bridge in about fifteen minutes, without difficulty. The fresh water used for the pump is contained in a cistern beneath, and seldom wants replenishing, as it is returned into the reservoir every time after being used.

The bridge was designed and erected by Mr. J. M. Rendel, about twelve years since, when he was engaged in improving the turnpike-road in the south of Devon.

The expense of repairing, oiling, packing, &c., since its erection, has averaged under 7*l.* per annum, including a small salary to a neighbouring millwright for occasional inspection.

The communication is accompanied by a drawing, showing a plan and sectional elevation of the bridge and the machinery.

"*An Investigation of the comparative loss by Friction, in beam and direct-action Steam Engines.*" *By William Pole, Assoc. Inst. C. E.*

In consequence of the comparatively recent introduction of direct-action steam engines on board the steam-vessels of the Royal Navy, the attention of engineers has been drawn to the advantages or disadvantages they possess, when viewed in comparison with those constructed with side levers. The object of this paper is to investigate the value of an apparently formidable objection which has been frequently urged against the direct-action engine, namely, "that from the more oblique action, consequent upon the shortness of the connecting-rod, the loss by the increase of friction is so considerable as to constitute a serious objection to this form of engine."

After explaining to what extent mathematical analysis is applicable for determining the amount of friction, the paper proceeds to show that it may be satisfactorily used in the present case, as it is only the friction caused by the strain, or load, which is involved in the objection, and this is more adapted for theoretical than experimental determination.

The three general laws of friction, as established by the best experiments, are,

1st. That the friction caused by one solid body rubbing upon another, is independent of the velocity with which the rubbing surface moves.

2nd. It is also independent of the area of the rubbing surface.

3rd. It is proportional to the pressure upon this surface.*

From these it will follow, that if the pressure upon a moving body be multiplied by a certain co-efficient of friction (whose value is dependent upon the nature of the rubbing surface), the product will be the resistance from friction; and this multiplied again into any space the rubbing surface moves through, will give the amount of "power, work, or labouring force," expended in overcoming the friction through that space.†

If the pressure upon the moving body be variable throughout its motion, the differential calculus must be employed, but the principle of calculation is still the same.‡

The paper proceeds to deduce general mathematical expressions for the amount of friction on each bearing of an engine, by finding, first, by ordinary statical rules, the pressure thrown on each particular bearing by a given force applied to the piston, and then combining this with the space through which the rubbing surface moves.

This is done for the beam engine, and for three modifications of the direct-action engine. Equations are also added for the oscillating or vibrating engine, and for an arrangement in which the connecting-rod is supposed to be indefinitely lengthened.

The numerical values of the expressions for friction thus found, are then calculated for an engine upon each of these different constructions, supposing them to be similar in all other respects, having the cylinders 66 inches in diameter, with a length of stroke of 6 feet; and the results are shown in a table, distinguishing the friction of every bearing.

From this it appears, that, as respects the

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* Poisson, Traité de Mécanique, 2nd edition, Art. 456.

† If m = the co-efficient of friction, P = the pressure, and S = the space moved through; then the power expended = m P S.

‡ Let x be any space moved through; let X represent the variable pressure, expressed in terms of x, then the power expended $= m \int X\, dx$.

friction caused by the strain, if the beam engine be taken as the standard of comparison—

The vibrating engine	has a gain of	1·1	per cent.
The direct-action engine with slides	,, loss ,,	1·3	,,
Ditto with rollers	,, gain ,,	0·8	,,
Ditto with a parallel motion	,, gain ,,	1·3	,,

This difference being so trifling, it is contended that the objection to the direct-action engine, on the ground of its alleged increased friction, has, when investigated, no adequate foundation.

Mr. Field believed that the paper was correct in its view of the comparative amount of friction of the two kinds of engines. He was of opinion that an excessive allowance for friction had hitherto been generally made in calculating their effective power. It was found practically, that when the pressure upon the piston was about 12lbs. per square inch, the friction did not amount to more than 1lb. or 1½lb. per square inch. This was easily ascertained by the indicator, when the engine was working without a load, but when loaded, he knew of no accurate experimental mode of showing it. At the engines of the Blackwall Railway, the experiment had frequently been tried, by casting off all the load, and so regulating the steam, that the engines should make only the regular number of strokes per minute; the result had invariably shown about 1lb. per square inch for friction.

Mr. Taylor confirmed the preceding remarks; it had been the custom formerly, in large pumping-engines, to allow one-fifth for friction; but modern practice had shown that this was not necessary, particularly since greater precision had been introduced into the construction of all kinds of machinery.

Mr. Miller agreed that the friction of engines generally had been overrated; he believed that as a simple comparison of the friction of the main parts of two kinds of engines, the results arrived at in the paper, might be received as correct; but there were several other questions which must be considered, if it was intended to establish a general comparison between the beam and the direct-action engines; this, however, he believed was not the intention of the author.

Mr. Murray contended that the second proposition in the paper which assumed that "friction was independent of the area of the rubbing surface," although supported by Coulomb and the early experimenters, had been proved by Vince and others to be incorrect: it was natural to suppose that in proportion to the hardness and smoothness of bodies, there would exist a different ratio for the best proportion of surface to weight for every different body; if a surface carrying a given weight was of less than the due area, the surfaces would cut into each other, become rough, and thus increase the friction; on the other hand, if the surfaces were unduly enlarged, there must be a loss from the additional amount of friction caused by the extended surface. He conceived that the calculations in the paper must be affected by the incorrectness of the data upon which they were based.

The simple mode of comparing the beam engine with the direct-action engine appeared to be, to suppose two engines of the same length of stroke and diameter of cylinder; the proportions being good, it would be indifferent whether the power was transmitted through a direct connecting-rod or through side levers; the cylinders, air-pump, arrangement of parallel motion, &c., being supposed to be alike, the friction of these parts would be alike in all cases, and the comparison would be limited to the parts employed in transmitting the power from the piston-rod cross-head to the crank-pin; both connecting-rods have the same number of bearings, which in both cases travel with friction over nearly the same distances: it is allowed that the bearings of the shorter connecting-rod have a larger amount of friction, and that from the greater angle it assumes, more friction is thrown upon all the bearings of the parallel motion, on account of the greater force required to retain the piston in a vertical position. To counterbalance the increased friction on these parts of the direct-acting engine, allowance must be made in the beam engine, for the friction of the beam centres, and of the top and bottom necks of the side rods. The friction being directly as the distance moved through, and the distance in the side-rod ends being so very small, it follows that the amount of friction must be very trifling. The distance travelled by the beam centres is greater, but it is not of importance, as it is the angular distance due to the vibration of the beam, measured on the circumference of the gudgeon. Under these considerations Mr. Murray was disposed to give the preference (if any existed) to the side-lever engine.

In a pamphlet* published in 1840, by Mr. John Seaward, it is stated that four-fifths of the whole friction of an engine were absorbed by the packings of the piston, and air-pump bucket, by the slide-valves and by the different packings or glands; con-

* "Description of the Engines on board the Gorgon and Cyclops Steam Frigates, with remarks on the comparative advantages of long and short connecting-rods, and long and short stroke engines." By J. Seaward. London, 1840.

sequently one-fifth was due to the whole of the necks or bearings throughout the engine. Now on considering the large proportion of this amount of the friction that is due to the bearings of the main shafts, of the crank-pin, and of the bottom end of the connecting-rod, and of all those other bearings common to both sorts of engines, it must be evident that the total amount of the friction due to those parts in which a difference between the engines exists, must be but a small portion of this one-fifth. Taking one-tenth or ten per cent. of the whole power of an engine, as the amount of power required to overcome the friction of the engine itself, which was allowed to be ample, one-fifth of this would be two per cent., and therefore the degree in which either engine could surpass the other in the amount of friction, could only be, as already stated, a small portion of this two per cent.

In comparing the efficiency of these engines, it would thus appear that neither could be said to possess advantages over the other, as regards friction, in such a degree as to be appreciable in practice, or to render the point of importance, in a choice between the engines; and that if the one kind of engine had advantages over the other, they must arise from other causes than difference in friction.

Having taking this view of the case with a supposed side-lever engine, of the same length of stroke and diameter of cylinder as the direct-action engine, if manufacturers varied in a slight degree from this proportion, it was for the purpose of obtaining a better proportion of stroke and diameter of cylinder, and consequently a better engine than the one supposed to exist for the purpose of making the observations.

Mr. Vignoles looked upon the second proposition assumed by the author, as being overthrown by the results of the experiments of Wood and others, as to the ratio of friction to the area of rubbing surface, and it was well known practically, that the application of various unctuous substances materially altered the amount of the friction. A certain proportion was requisite between the area of the surface exposed to the friction, and the pressure upon it, to bring it within the general law. For practical purposes, he submitted that the law should be received with limitations.

Mr. Gravatt said, that even allowing, for the sake of argument, that the second proposition assumed by the author was incorrect, still, as the paper was only a theoretical examination of the comparative friction of those parts of two kinds of engines, which were most subjected to strain, supposing them both to be of similar power and dimensions, equally well-proportioned and constructed, and the same sort of lubrication of the bearings employed, he would contend that, the circumstances being equal, equal results would be obtained, and that the conclusions arrived at by the author should be received as correct.

Mr. Pole observed, that the objections brought forward were important, as they referred principally to the fundamental laws of friction. He would first give some explanation respecting the communication itself. The investigation was commenced at the request of his late friend, Mr. Samuel Seaward; it was originally intended to have especial reference to the Gorgon engine, but had subsequently been extended to others. The paper, necessarily containing much mathematical reasoning, could only be read in abstract, and might, therefore, have been partially misunderstood, both as to its objects and results. The object was, not to enter into a discussion of the whole question of the respective merits or defects of beam and direct action engines, but simply to ascertain the value of the one objection named. The whole friction of an engine at work, with its load upon it, might be divided into two distinct parts. 1st. The friction due to the engine itself, or such as would be produced by the working of the engine, if unloaded. 2nd. The additional friction caused by the strain consequent upon the load; for it must be evident that, when the engine had its work upon it, the friction upon the bearings through which the strain passed must be increased, and additional friction produced, beyond that which would exist when the engine was working without a load. The latter of these alone required to be calculated, and to this mathematical analysis was more peculiarly adapted. The friction of the engine unloaded might be ascertained by the indicator, as described by Mr. Field; but, as he had remarked, there was no practical method of finding what was the additional friction when the load was applied; indeed, it would be as difficult to find the latter by experiment as the former by theory. Mr. Pole then explained the manner in which the amount of friction upon each bearing had been calculated, and engines of different constructions compared with each other. He had adopted precisely the plan suggested by Mr. Murray, namely, by taking engines of the same length of stroke and diameter of cylinder, supposing them to be equally well proportioned and constructed, and in equally good condition. But instead of assuming, as Mr. Murray had done, that there was somewhat more or less friction on any particular bearing, his object had been to ascertain what was its actual value. If it were impossible to measure the pressures,

and spaces moved through, an approximation might be received; but since these quantities were ascertainable, it was more satisfactory to obtain results deduced from them. The conclusions drawn from the paper accorded, however, with Mr. Murray's, viz., that "neither construction could be said to possess advantages over the other, in such a degree as to be appreciable in practice, so as to render the point of importance in a choice between them." The difference between Mr. Murray's process and that in the paper was, that what the former only assumed, the latter endeavoured to prove. Mr. John Seaward's pamphlet on the Gorgon engine had been referred to. The conclusions he there drew were more favourable to the direct-action engine, but were derived, like Mr. Murray's, merely from approximate consideration, rather than from strict investigation. Mr. Seaward confessed, that the friction caused by the strain was difficult to be calculated, and had therefore contented himself with assuming, that those gudgeons through which the strain passed had three times as much friction as was due to the others. He also assumed that the friction was proportional to the area of the rubbing surface, a principle which no experiments had ever shown. On these grounds it was contended that Mr. Seaward's results were open to objection. Mr. Pole then proceeded to notice the objections urged against the fundamental laws of friction which he had stated, and to give authorities for them. The first of these had not been questioned since the days of Vince, by whom it was proved; it might, therefore, be considered as established. With regard to the second and third, it must be noticed that they depended, in some measure, upon each other, for it could be proved, that if the third was true, the second must be true also. The principal experiments which had been made upon the friction of solids were those by Amontons, in 1699; Coulomb, in 1779; Vince, in 1784; Wood, in 1818; Rennie, in 1828; and Morin, in 1831, 32, and 33. Amontons was the first who devoted any considerable attention to the subject, and he found that friction was not augmented by an increase of surface, but only by an increase of pressure.* Coulomb's researches were more elaborate, the experiments were on a large scale, and were submitted to a great variety of trials; they fully proved that the friction was proportional to the pressure, and that the extent of surface did not affect it.† These results were further confirmed by the experiments of De la Hire, Ximenes, Boistard, Rondelet, and others. Mr. George Rennie's experiments were very valuable, as having been conducted on a large scale, and with much care; they were also of a comparatively recent date. The results were conclusive on the point in question; for he found that when the surfaces were to each other as 6·22 : 1, the friction remained the same;* and one of the general conclusions he deduced was, "that the amount of friction was as the pressure directly, without regard to surface, time, or velocity."† The last and most extensive series of experiments were those by M. Morin; they were conducted at Metz, by order of the French government, and extended over a period of three years, (1831, 1832, and 1833,) no expense or trouble having been spared to render them conclusive and satisfactory.‡ The results were given by Professor Moseley, in his new work on the Mechanical Principles of Engineering.§ They proved that "the friction of any two surfaces was directly proportioned to the force with which they were pressed perpendicularly together," and that "the amount of friction was, in every case, wholly independent of the extent of the surfaces of contact."‖ The before-mentioned experiments all agreed that the friction was proportional to the pressure, and was independent of the extent of surface.¶

(To be continued.)

* Vide Phil. Trans., 1829, p. 145.

† Mem. des Savans Etrangers, 1781. Vide also Ency. Brit. New Edit., Art. Mechanics.

NATURAL AND ARTIFICIAL COAL.

During the last week a series of very interesting experiments have been made at the Polytechnic Institution, to test the value of a new species of artificial coal invented and patented by M. Joscelin Cooke, Esq., as compared with the best natural anthracite. Mr. Cooke's specification not having been yet enrolled, we cannot state what the component parts of his coal are; but we understand that it is chiefly made up of the refuse of average small Newcastle coal. It has a

* Phil. Trans. 1829, p. 156.

† Ibid. p. 170.

‡ Mem. de l'Institut., 1833, 1834, and 1838.

§ The Mechanical Principles of Engineering and Architecture. By the Rev. H. Moseley, M.A. 8vo. Longman and Co., 1843.

‖ Ibid. pp. 138, 139.

¶ The reader will find, on reference to our review of Professor Moseley's work, (vol. xxxvii., p. 498,) that this is rather an imperfect statement of the result of the experiments referred to, which have been, by no means, of the conclusive nature here represented. In all these experiments, the pressing weights were laid upon or above the bodies pressed; but, before the law deduced from them can be admitted to hold universally, it ought to be further ascertained what the results are when the weights are *suspended from and turn upon* bearings of various sizes and qualities.—Ed. M. M.

very compact appearance, burns brightly, has no tendency to caking, and yields a very small portion of ashes. The experiments were made by alternately working the steam-engine of the Institution with the Welsh and with the patent coal, for whole days at a time. From the results, which are exhibited in the following table, it will be seen that the difference of consumption, though not great, was in favour of the patent fuel. It must, be remembered, however, that while the average small Newcastle coal costs only 15*s*. 2¾*d*. per ton in the Pool, the best Welsh costs 17*s*. 11*d*.; what the refuse of the former may be had for we do not know, but we should suppose for not more than one half as much. To the gain, therefore, in point of quantity, must be added the still greater gain in point of price; so that the difference in favour of the patent fuel must altogether be very considerable.

No. 1. Welsh.

Time	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10 o'clock.
Pressure	0	7	25	30	28	23	27	32	32	30	15	—	25	32	32	25 lbs.

No. 2. Welsh.

Time	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10 o'clock.
Pressure	0	5	25	31	30	24	29	30	32	20	11	—	30	32	31	10 lbs.

No. 3. Cooke's Fuel.

Time	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10 o'clock.
Pressure	0	5	20	28	30	30	31	30	31	25	12	—	29	32	28	10 lbs.

	cwt.	qr.	lb.		lbs. per inch.
Quantity consumed, No. 1.......	4	3	14	Average pressure, No. 1.......	25·9
2.......	4	2	0	2.......	24·2
3.......	4	2	0	3.......	24·3

NOTES AND NOTICES.

Tides at Otaheite.—That it is invariably high water at noon at the island of Otaheite has been a received fact ever since the days of Cook; but it now appears from a tide journal kept at the harbour of Papeete by Mr. Richardson, R.N., and communicated to the Royal Society by Captain Sir Edward Belcher, that this is not correct—though certainly the cause of the tides at this island do present some anomalies very difficult to account for. "By a reference," says Sir Edward, "to the tide registry annexed, it will be found that there are two distinct periods of high water, during each interval of twenty-four hours; and that during the seven days preceding and seven days following the full and change, they are confined between the limits of 10 a.m. and 2h 30m p.m., the whole range of interval, by day as well as by night, being about 4h 27m. Commencing with the seventh day preceding the full moon, viz. the 9th of April, it will be perceived that high water occurs at 10 a.m., this being the greatest a.m. interval from noon; and that on the 16th, at the full moon, it occurs nearly at noon. Passing on to the 23rd, it reaches the greatest p.m. limit at 2h. 30m., and on the 2nd of May it again reaches the noon period. Between the 23rd and 24th, however, a sudden anomaly presents itself. Throughout the day of the 23rd, the variation of the level does not exceed 2½ inches, and the general motion is observed to be "irregular." The time of high water is also the extreme p.m. limit. On the 24th we discover that it has suddenly resumed *the most distant* a.m. *period*, viz., 10 a.m., but proceeds regularly to the noon period at the change. Although the differences of level do not at full and change exceed 1 foot, 4½ inches, still I presume that we have sufficient data to establish the fact,—that it is *not invariably high water at noon* (as asserted by Kotzebue, Beechey, and others:) and, further, that we have corresponding *nightly periods* of high water. It is evident that the time of high water at full and change may be assumed as that of noon, because we have sufficiently decided changes of level to fix the approximate period of high water. It does not appear by these registers, that any higher levels result from the rollers sent in by the strong sea breezes, (as asserted by several writers,) but rather the contrary, the highest levels being indicated during the night, when the land breezes prevailed."

Messrs. Hawthorn's New Locomotive Engine.—On the 11th April, a splendid and powerful new locomotive engine, the *Star*, manufactured by the house of Messrs. R. and W. Hawthorn, Newcastle, made its first trial trip on the railway from Carlisle to the cut in Cardew Mines, a distance of six miles, which, on returning, was passed over in ten minutes, including one stoppage. The trial was in every respect saticfactory, both as regards speed and fuel. The quantity of fuel consumed by this engine is considerably less than any engine upon the common construction. The *Star* is constructed on Messrs. Hawthorn's patent principle, having return tubes in the boiler, in consequence of which, the caloric traverses twice its length, thus giving it a greatly increased evaporative power.—*Carlisle Patriot.*

How to imitate the appearance of the corona that surrounds the body of the moon during total darkness in total eclipses of the sun; and also the appearance of the beads that occur in total eclips s, just prior to the time of total darkness, and in annular solar eclipses.—Place a candle in the focus of a lens, fixed in a screen, with an aperture of about three-quarters of an inch in diameter; on the opposite side of which screen place an opaque circular disc, of equal (or even greater) diameter than the aperture, which may be placed at different distances, so as to produce an eclipse of any magnitude, as the spectator shifts his position. When it is central and total, there is a brilliant ring, or glory, even when it is so much nearer to the eye as to subtend a much greater angle than the aperture. And when there are any cusps, minute irregularities, on the edge of the disc, they produce distinct *beads*. A similar experiment has been tried with the circular opaque disc and the rays of the *sun* reflected from a small piece of glass, which produced a most brilliant ring, the disc being nearly double the apparent diameter of the sun.—*Rev. Baden Powell—Trans. Royal Soc.*

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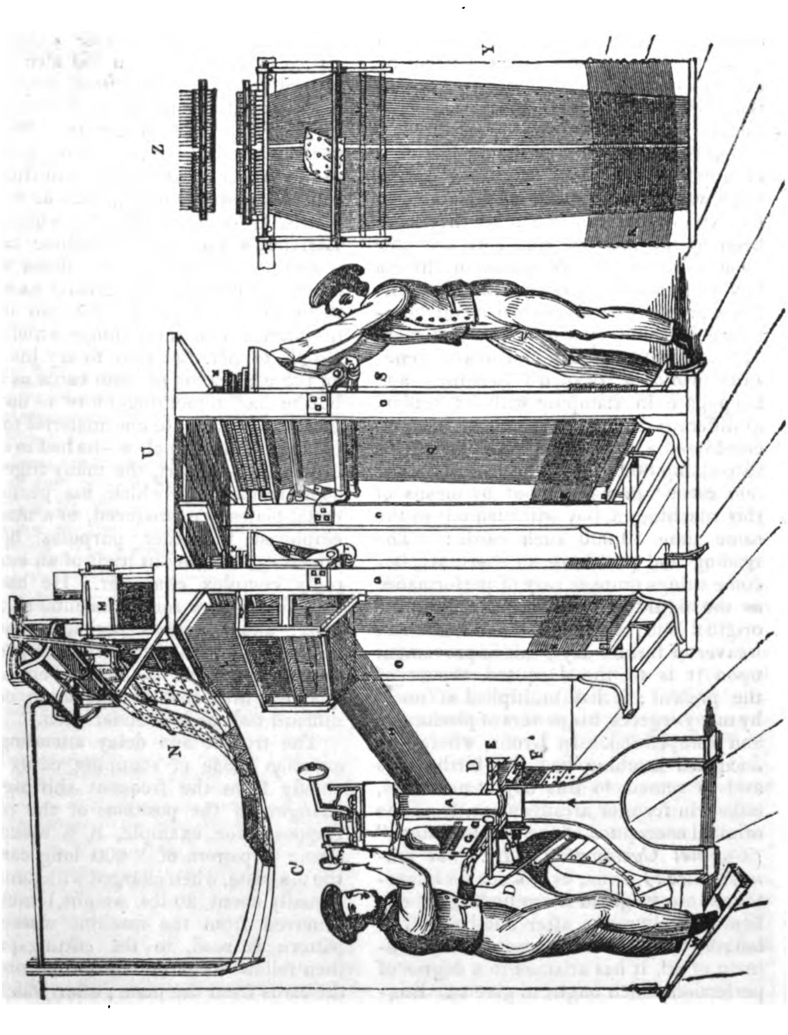


LARIVIERE'S PATENT MACHINE FOR READING AND STAMPING CARDS FOR JACQUARD LOOMS.

LARIVIERE'S PATENT MACHINE FOR READING AND STAMPING CARDS FOR JACQUARD LOOMS.

[Patent dated March 1, 1842; Specification enrolled September 1, 1842.]

Every one acquainted with the process of figure weaving knows how wonderfully it has been simplified by the introduction of the "Jacquard" machine, so called after the ingenious silk weaver of Lyons, by whom it was invented; and he must at the same time be aware, that so far as regards celerity in the *reading* and *stamping*, or *punching* of the pattern cards previous to setting the machine to work, there was still much left to be desired—that these, in fact, were operations of a most operose and tedious character. We question, however, whether it has ever entered into the imagination of any one to conceive that the operations we speak of could be facilitated to so extraordinary an extent as they have been by the machine which we are now about to describe. With this machine a boy of ordinary capacity can, after one day's practice, do more than could heretofore be done by a dozen expert men. He can stamp as quick as a weaver generally works a Jacquard machine, and keep pace in stamping with six readers at different frames. It has been hitherto considered a good day's work for a man to restamp 800 of what are called "long 600 cards" in a day; but by means of this machine, a boy will turn out in the same time 10,000 such cards! The reading and punching, in short, are become things quite as easy of performance as the figure weaving itself. What the original Jacquard loom was to the silk weaver of former days, this improvement upon it is to the Jacquard weaver of the present; it has multiplied at once, by many degrees, his powers of production and competition. In Lyons, where the Jacquard machine had its birth, it is said to remain to this day "unaltered, either in form or arrangement, from the original conception of the first inventor;" *(Cabinet Cyclopædia, Art. Silk manufacture;)* while, ever since its importation into England it has undergone one beneficial alteration after another, till at length, by this last and greatest improvement of all, it has attained to a degree of perfection which ought to give our English weavers (if they are but true to themselves,) a long start a-head, not only of their Lyonese, but of all other foreign competitors.

It should serve, however, to moderate any feeling of national vanity which the contemplation of this gratifying result is calculated to awaken, that for this improvement we are indebted, as we are for the machine itself, to *foreign* genius. The inventor of the reading and stamping machinery, which is the subject of our present article, is Mr. Marc Lariviere, a gentleman of Genevese extraction, settled in England, who has already, by several valuable inventions, acquired a high reputation amongst us for mechanical contrivance and dexterity. We may particularly mention, as being germane to the matter in hand, the beautiful articles in perforated metal, such as window blinds, fire-screens, &c., for which Mr. Lariviere's factory has become famous—rivalling as they do the finest woven tissues in delicacy, and greatly excelling them in accuracy. It was, no doubt, his success with these things which suggested to Mr. Lariviere to try his hand on the perforation of loom cards as well; but he had something more to do than merely to substitute one material for another under his punches—he had to adapt, in whole or in part, the many ingenious combinations by which his perforated metal plates are produced, to a machine employed for other purposes besides punching, and one in itself of an exceedingly complex character. He had, in fact, quite a new sort of machinery to invent; and the most, perhaps, that can be said with truth of his previous practice in the same line is, that it eminently qualified him for the execution of the difficult task he had undertaken.

The trouble and delay attending the common mode of stamping cards arise chiefly from the frequent shifting and changing of the positions of the plates. Suppose, for example, it is wished to stamp a pattern of "600 long cards;" the top plate, when charged with punches, (usually about 20 lbs. weight,) must be removed from the machine where the pattern is read, to the cutting-press; then follow the stamping and beating off the cards from the plate; after which the plate must be replaced on the machine, the punches driven back in the box, and so on. In the patent machine, on the contrary, the plates are never removed

from their fixed positions. Another great source of hindrance in the case of the common Jacquard machine is the time required for shifting the reading frame every time a different pattern is required to be produced. But with Mr. Lariviere's machine the reading frames are so constructed that they can instantly be detached from, or attached to, the machine as often as required.

The new machine is represented in the prefixed engraving in the operation of re-stamping cards. A A, is the framework of the punching press; B, the case containing the plates and punches; C, the comb, shown separately at Z, by inserting which its teeth catch hold of those punches only which remain down while they prevent those which have been drawn up from dropping till the comb is withdrawn; C^2, the lever by which the press is worked with one hand while the comb is pushed in and out by the other; D D, two square rollers, by the revolving of which the cards are carried forward as soon as punched; E, catch lever by which the rollers are made to revolve; F F, brackets, which allow the machine to be adjusted for 400 or 500 cards; G, plate covering the box containing the punches; H, the cords attached to the punches, corresponding to the arrangements of the Jacquard machine M, (worked by the foot lever W,) and to samples of the Norwich and London ties.* J, elastic springs, with iron rods, K, (used as weights,) attached to the cords to keep them in a proper state of tension; L, continuation of cards corresponding to those attached to the punches; N, the set of cards which are being re-cut by the man at the press; O O O O, framework of the reading and transmitting parts of the machinery; P and V, samples of the London tie; Q and U, samples of the Norwich tie; R, the lashes which form the pattern, each lash consisting of a certain number of the threads of the warp which have been pushed out or separated from the rest, whereby the punches attached to the cords H, at the opposite end, are drawn up out of the way of the teeth of the comb C; S, moveable hand-roller, by the insertion of which the lashes are separated from the rest of the cards; T T T T, the levers by which the punches are drawn up; Y, reading or pattern frame which rests on ledges at X, and may be fitted in, or removed from the machine at pleasure.

The machinery is applicable to every sort of figure weaving, and sufficiently powerful to pierce thin sheets of copper, zink, or tin, or any others required by carpet manufacturers and others.

ON MR. PILBROW'S SUPPOSED DISCOVERY OF "A NEW FORCE IN STEAM."

Sir,—Mr. Pilbrow is no doubt a man of very ingenious ideas, and your correspondent, "Scalpel," is a very ingenious writer, but their minds are evidently of a too ardent and imaginative cast to enable them to make a sober philosophic induction, from some experiments by the former on the impulsive force of an effluent current of steam. This mental peculiarity is also unfortunately combined with very unsound views of the mechanics of the subject, and hence they have been led to regard as a "discovery of a new force" in steam, what, at the most, *cannot* be more than a somewhat advantageous practical arrangement for lessening the great loss of power, which always attends the application of steam on the principle of emission, whether that principle be carried out through the medium of recoil or that of impact.

* The difference between the London tie and the Norwich tie is thus described by the writer of the article on the Silk Manufacture, in the "Cabinet Cyclopedia:"—"To give an intelligible account of the alteration thus effected, it is necessary to explain that the cords whereby the leaden weights, which are called lingos, are attached to the harness, are each led through a hole in a board, in front of and somewhat lower than the breast-roll of the loom —this is called a comber-board; and its numerous holes are so disposed in lines, that the rows which cross the loom comprise a greater number of holes than the holes which run in the direction of its length. On the other hand, the rows of lifting-hooks contained in the apparatus before described are in the greatest number in this last-mentioned direction. In attaching the harness to the lifting-hooks, it had been usual to connect each cord with that individual hook which would have stood in the most natural relation to it, provided the comber-board and lifting-hooks had stood in the same direction; but, as they do not so stand, it is evident that the disposition of the cords must occasion twisting of them among each other; and hence arose the necessity for carrying them through a wider range of space, that the chance of entanglement or confusion might be diminished. This mode of connecting the harness with the lifting-hooks is called the *London tie*. The improvement consists in connecting each cord with the individual hook which stands in the most natural relation to it in the actual position of the different parts—this is called the *Norwich tie*; and, by reason of its diminishing the chances of entanglement among the numerous cords, makes it practicable to confine the harness within a narrower range of space."

I have myself placed on record in your Magazine my opinion, that the loss of power on this principle is not *necessarily* so great as it has been found in practice, or as asserted by writers on the subject; and that the extent of the loss depends altogether on the practical method of applying the principle, and may be diminished to so great a degree, as to produce a really efficient engine under circumstances requiring considerable velocity;* but I never dreamed that the plan I myself had in view, or that of any other person, would amount to "the discovery of a new force" in steam; or imagined, that "the *real* force which steam is found to possess in its expansive velocity has never been known." By taking such high ground—by talking of "a discovery in the *properties* of steam"—of a grand discovery hitherto unknown in science—"of obtaining a *double* power" in the "*additional* force of *reversal*," and of "*only* the force of impact," being secured by the ordinary means—by using, I say, these and other strange, but *ad captandum* expressions, and which are otherwise wholly irrelevant and unmeaning, both your correspondents have laid themselves open to the imputation—and very justly by implication—of having contended for an actual duplication of the inherent power of steam, by a sort of *quasi* perpetual motion arrangement, whereby is obtained "the other half," which has not hitherto been appropriated. Their words convey the meaning, either of the *generation* of a new force by mechanical arrangement, (which is the principle of perpetual motion constructively acquired,) or of the self-generation of this force in the act of the efflux and expansion of a current of steam (which is the principle of perpetual motion obtained by natural means,) some of their expressions applying best to one of these ideas and some to the other. But to do your correspondents justice, they do not really mean what their words imply, or what indeed they say they mean, for in serious earnest they claim expressly no greater amount of duty to be obtained from steam in their way, than in the ordinary manner on the principle of pressure, "under the very best circumstances of expansion." By this admission they renounce all that is novel and magnificent in their claims, and the inconsistency must be attributed to an enthusiastic temperament acting on an imperfect grounding in mechanical science. Only the most confused views of things can be seen through such a hazy and magnifying medium.

Their real meaning then, is, that the expansive force of steam, *apart from the pressure derived from an immediate connexion with the boiler*, is as available to mechanical purposes, and equally as efficient when suffered to generate velocity in steam, and applied therefore on the principle of emission and impact, as when applied in the ordinary way on the principle of pressure acting slowly on a piston. They further mean, that the *whole* projectile force residing in steam, as arising, both from the initial pressure and the subsequent expansion of the effluent current, is thrown out in one and the same direction—that of its issue from an aperture or tube; that it is not disturbed and dispersed by lateral action, and therefore may be arrested and appropriated by a suitable arrangement, with a mechanical effect equal to what is obtained by pressure. In these views, at least as theoretically accepted, they are undoubtedly correct, however oddly in point of science, and magniloquently in point of language, they may have propounded them; but there is nothing new, nor I fear of much value in them, either in principle or in practice. The "new," the "double," the "additional" force, turns out to be nothing more than a practical increase of *effect*, through a saving of the power that otherwise would have been wasted; and as to its being *double*, that is only a fancy, arising from viewing it as a newly discovered force, as being "the other half" not identical, as they say, with the force of impact, but with "the force of reversal." Mr. Pilbrow ought to obtain much more than "a double effect from using a cavity, instead of a flat plate," on which the current of steam shall impinge, to "give as much duty as a piston in a cylinder worked under the very best circumstances of expansion." It ought to be treble at least, and this trebling must be, not of the impulsive pressure on the surface having the cavity, but of the product of the pressure and velocity at the maximum effect. The momenta in the two cases

* See No. 932, Vol. xxxiv., but in which some typographical errors have rendered my meaning, in a few particulars, very obscure.

must be as 1 to 3, which is a very different affair from the pressures being in that ratio.

There is nothing at all wonderful, as your correspondents imagine, or indicative, in the least degree, of a "new-found power," in the fact of the impulsive pressure being double, or, according to Mr. Pilbrow's experiments on an immoveable concave surface, somewhat more than double the pressure which gives birth to the velocity of the effluent current, as estimated on the area of the tube or aperture; for such impulsive pressure is not communicated from the other, but is generated anew, and is the result of the *momentum* of the current, or of the generating pressure and velocity combined. On the supposition, therefore, of the whole of the power passing from the cause to the effect, or, in Mr. Pilbrow's words, "of the effect being equal exactly to the amount of power which would have been required to have pumped into a vessel the same quantity of gas to the same density," the pressure of the impulse, if only equal to the generating pressure, should have an equal velocity also, and if only double its amount, should have half the velocity of the current; instead of which, the surface, or cavity rather, upon which the steam impinged in those experiments, was immoveable. In short, the pressure on this surface, if moveable, should, (on the supposition of no power being lost,) be so much greater than the generating pressure, as the velocity of the surface is less than that of the issuing steam. From this Mr. Pilbrow and "Scalpel" may form some conception of the very serious loss of power which, to use an expression of the latter, must, *ex necessitate rei*, be incurred, by working steam on the principle of impact; especially when they consider that the velocity of steam rushing into a vacuum is, by mathematical calculation, about 1640 feet in a second.

I cannot conceive that it is possible for the very best mechanical arrangements that will ever be discovered, to raise the duty, on this principle of applying steam, to more than 60 or 70 per cent. of the power expended. But let us take Mr. Pilbrow's experiments for data, since they are to usher in "the grandest and most original discovery of the age." Making, then, the steam to impinge on cavities: taking the pressure thus produced to be as he found it, when they were immoveable, namely, double that due to the velocity; and assuming this impelling force to be in the simple ratio of the relative velocity; the maximum effect is when the velocity of the wheel is half that of the steam, the pressure on it being equal to that due to the initial velocity, and, consequently, its amount is 50 per cent. of the power. But this is assuming the force to be as the relative velocity: now, the hypothesis best applicable to the case is that of its being in the ratio of the square of the relative velocity, and is, besides, agreeable to Mr. Pilbrow's experiments, for his table (which, by the bye, appears to be incorrectly printed,* being inconsistent with itself,) gives the impulsive pressure in the ratio of the generating pressure, and consequently in the ratio of the square velocity. The maximum effect, therefore, is when the velocity of the wheel is one-third that of the steam, the pressure on it being eight-ninths of that due to the initial velocity, and consequently its amount is now only about 30 per cent. of the power. And this is obtainable only when the velocity of the impelled point is 32,800 feet in a minute, or approaching to half the velocity of a cannon-shot. Your readers need not be told that I do not place much reliance upon mathematical calculations of this sort; but they occasionally serve to give us rough approximations in such matters, and in the present instance, the second formula, now corrected from experimental data, gives results in accordance with those obtained in practice in the case of undershot water-wheels. I ought also to observe, that Mr. Pilbrow's steam wheel may, for aught I know, (not yet exactly understanding its construction,) give much better results than these; I only take as data the preliminary experiments, from which both he and "Scalpel" prognosticate success, and if they have nothing better upon which to ground their expectations, the whole scheme, in practice as well as in theory, must be a complete failure.

I now proceed to notice the claim to novelty and originality that is preferred, both for the principles and their application. It surely never happened to these gentlemen to be boys and play at pop-gun, or they would have recognised as something common enough, the principle of an elastic fluid, imparting motion to

* The table is printed, we believe, exactly as it appears in the specification.—Ed. M. M.

a body by an impinging projectile action due only to expansion, that is to say, on the pellet after it has left the tube. There is little of the continuous pressure in this case as in that of gunpowder, but even in the case of balls and cannon shot, there must be a considerable impinging action upon them after they have left the muzzle, to which the recoil in the piece, must, in a good degree, be attributed. Mr. Sievier, in order to turn this principle to greater account, reversed the practice, and made the tube the projectile; by which the gases of the inflamed gunpowder, with the velocity due to their expansion, continued with singular effect to *strike* and act upon the air, after they had acted by *pressure* upon the end of the rod from which the tubulated projectile was shot. As to the other principle, the absence of lateral expansion under these circumstances, surely these gentlemen must ever have been too refined in their manners, to blow their tea when it was hotter than it was convenient to drink, or they would have discovered, that a current of elastic fluid, not only does not expand laterally, and only in the direction of its issue from an aperture, but that it induces the surrounding air to some extent to accompany it in its progress; from which, and the expansion, the cooling effect is derived.

But ascending from the science of the nursery to the graver pastimes of philosophers, and reverting to "the double force," or the pressure of impact being greater than that which remotely originates it, surely these gentlemen could never have heard of the experimental investigations of Bossut, of Smeaton, of Vince, of Venturi, of Buat, and of Dr. Young, or they would not have claimed for the facts that Mr. Pilbrow has but verified, the credit of being discoveries in science. In Bossut's Hydrodynamics it is recorded, that in the case of an immoveable surface being struck by an isolated vein of fluid, the height of the column due to the impulse appears to be *double* that due to the velocity; or in other words, that the impulse is double the amount of the pressure generating the velocity, estimating it on the area of the impinging vein. Mr. Vince made the difference between theory and experiment as 514 to 900. Du Buat accounts for this effect, by stating, that the vertical vein of fluid in Bossut's experiments enlarged in striking the surface upon the balance; and that the resistance was not merely the impulse of the vein whose diameter was that of the orifice, but also of a ring of the fluid of a certain extent, around the circular base of the vein in contact with the resisting surface. Smeaton also attributes the discrepancy between the mathematical theory of the undershot water-wheel and the results of his experiments, to the "impinging sheet of water, when even not more than ⅛th of an inch in thickness, acting on the whole surface of a float whose height was 3 inches"—this practical point, being, as usual, neglected by the mathematicians.

Of course, resistance in respect to fluids depends greatly on the form that is given to the body; and whether acting, or being acted on, the convex is found to diminish, and the concave to increase the resistance. This is not more a deduction from the experiments of Mr. Pilbrow, than it is a dictate of the plainest common sense and of the most ordinary observation, and acted upon from time immemorial. Hence various forms and dimensions in reference to the depth of the impinging sheet of water, have been adopted in the floats of the undershot water-wheel, and among the rest, *curved* floats have been used. Thus, neither Mr. Pilbrow's principle, nor his practice—I mean, so far as the one is truly enounced, and the other is judicious—has any claim to originality, for the circumstance of one application being to an elastic, and the other to a non-elastic fluid, has no other influence on the question than to prove how erroneous are his views, in attributing the alleged newly discovered fact to expansion, seeing that it is found in cases where no expansion exists. Any practical arrangement by which the *momentum* of particles of matter is more effectively, and also more extensively arrested, must of course have the same mode of operation, whether the motion of those particles has been produced by a continuously acting pressure, with or without elasticity in the fluid; or from an expanding elastic force; or from this force and pressure combined. Dr. Young, however, instituted experiments with *air* as the impinging fluid, some of which were directed, if I rightly recollect, to the ascertainment of this very point—the pressure of the impact compared with that on the area of the aperture; but I have not his work at hand to refer to. This surplus pressure will, as I have just

said, vary in amount with the form of the resisting surface, but as it has been found to be on a plane nearly double that of the generating pressure, "the double force" which Mr. Pilbrow obtains, is to a very small extent due to the cavities on which the steam impinges; whereas, your correspondents say, that it is to be attributed solely to that cause; instrumentally at least, it is the only means of appropriating their "new found" "additional force."

The impact of an elastic fluid in the form of a jet, has seldom been employed as a mechanical power, and therefore the best mode of applying it, has not been the subject of much investigation. The æolopile of our forefathers as used in the turning of the roasting spit, was, however an engine of this description; and Branca appears to have made it efficient for more important mechanical adaptations, such as putting stampers in motion for pounding. He must indeed have experimentally investigated the subject, for instead of making the steam impinge on vanes, as was the most obvious mode, and as others had done before him, he chose to anticipate Mr. Pilbrow, and directed his jet into cavities in the periphery of his wheel, as may be seen by his own delineation of the engine, as given by Stuart from the original work published at Rome.

However cordially your correspondents agree in other matters, they do not take the same view of the nature and measure of power, but differ respecting it in quite opposite directions. Mr. Pilbrow says, "that all motion is power, *power in proportion to the velocity of motion*," and that "steam possesses in its mere velocity alone a propulsive force equal, &c.," but "Scalpel" more than makes amends for this omission of mass, weight, or pressure, according to the different aspects, which power presents, by adding thereto velocity once and again! This "double" dose is administered by him in his last communication, No. 1026, where he says, "the great fundamental principle of the variation and measure of power—*momentum* multiplied by *velocity*—is here our guide." No wonder he has been led astray. There *is* such a function, though "Scalpel" was not aware probably of what he was describing; but in truth, neither impetus, momentum, nor velocity, is a measure of mechanical power as it was called by Smeaton; or of its effect or duty as Watt termed it; time being an element altogether omitted in the estimation of their efficiency, the criterion of which is, force multiplied simply by the space through which it acts.

I am, Sir, yours, &c.

BENJAMIN CHEVERTON.

SCREW PROPELLING—THE "MERMAID."

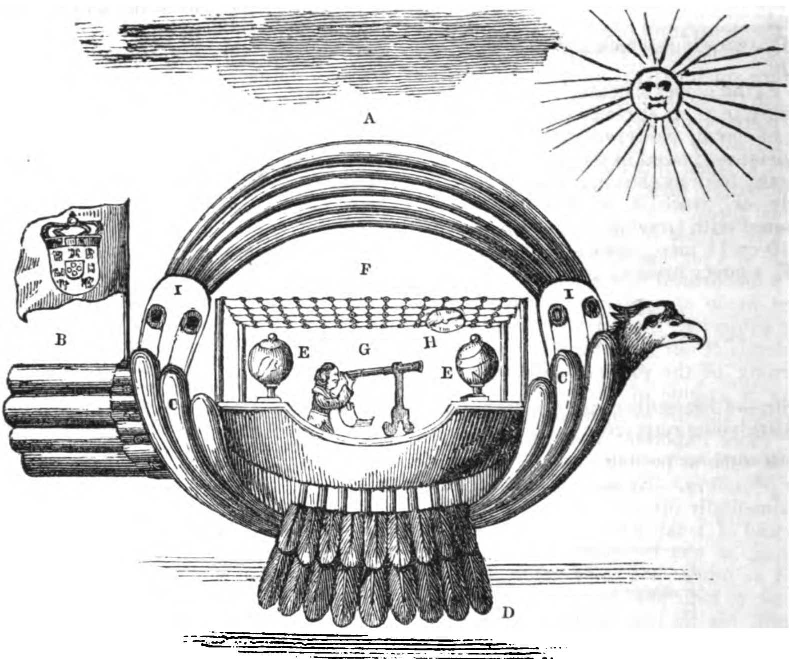
The *Mermaid*, with Mr. George Rennie's conoidal propeller, the extraordinary performances of which we noticed in our last Number, made another excursion down the river, last week, when she fully sustained her previous reputation—having accomplished the distance between Blackwall and Gravesend, with the last quarter-ebb tide, in one hour and nineteen minutes. The vessel is 130 feet long between perpendiculars, 16 feet 6 inches broad, 9 feet deep in hold, and of 164 tons burthen. She has two engines, on the direct-action principle, of 45 horses' power each, which, with the boilers and appendages, weigh altogether only 47 tons. The cylinders are of 37 inches diameter; the length of stroke, 32 inches; number of strokes per minute, 35 to 36. The motion is communicated to the propeller through the medium of two pairs of cog-wheels.

POWDER-MILL EXPLOSIONS.

Sir,—Permit me to offer a few observations on the probable causes of the accidental explosion of powder-mills. In cases where hard metals are used in parts of the machinery, or in the manipulation, grit may sometimes occur in the metal itself, introduced in the process of casting—or grit may be carried in on the four winds—or the metal itself, by sudden fracture, may generate fire, call it electricity, or by any other name. Sometimes in the cooling of the metals, after casting, crystallization takes place, so as to form crystals in the metal as hard as grit itself. I only hazard these observations with a hope to induce better informed men to give their attention to so serious a subject as the accidental explosion of powder mills, and am your obedient,

JOHN NORTON,
Late Captain, 34th Regt.

ANCIENT FLYING MACHINE.



It may not be uninteresting to our readers, at a time when the ingenuity of Mr. Henson has led the public anxiously to expect the solution of a most interesting problem, to be presented with an accurate drawing of a project for traversing the aerial regions, purporting to be the invention of a Brazilian priest, one Bartholomew Laurent, nearly a century and a half ago. Nor need Mr. Henson labour under any apprehension of our lessening the glory to be derived from his discoveries by bringing to light this one among the numerous attempts that have been previously directed to the same end, as a very brief inspection will serve to convince the reader, that though worthy of notice as a curiosity, the invention of Laurent is not remarkable for the value of its scientific details. The sketch and accompanying description are taken from the *Evening Post* for December 20, 1709. The inventor seems much inclined to deal in mystery: aerial progress is to be attained by a "secret operation" of amber beads; loadstones are to *attract* the vehicle forwards, and the homely assistance of a "pair of bellows" must be had recourse to "when there is no wind." The speed contemplated—200 miles in 24 hours—does not appear, to our modern notions, accustomed as we are to the rapidity of railway travelling, very extravagant; but how the ponderous apparatus was expected to be raised or propelled by means of such sails as are represented in the drawing, we are wholly at a loss to conceive; and were there not strong evidence of the inventor's being in earnest, we should be disposed to pronounce him one of that strangely-compounded class of individuals, who take pleasure in jokes of a vastly dull and elaborate character.

Inventor's Explanation of the figure.

A represents the sails, wherewith the air is to be divided, which turn as they are directed.

B, the stern to govern the ship, that she may not run at random.

C, the body of the ship, which is

formed at both ends scollop-wise: in the concavity of each is a pair of bellows, which are to be blown when there is no wind.

D, two wings which keep the ship upright.

E E, the globes of heaven and earth, containing in them attractive virtues. They are of metal, and serve for a cover to two loadstones, placed in them, upon the pedestals, to draw the ship after them, the body of which is of thin iron plates, covered with straw mats for convenience of 10 or 11 men, besides the artist.

F, a cover made of iron wire, in form of a net, on which are fastened a good number of large amber beads, which by a secret operation will help to keep the ship aloft; and by the sun's heat, the aforesaid mats that line the ship, will be drawn towards the amber beads.

G, the artist, who, by the help of the celestial globe, a sea-map and compass, takes the height of the sun thereby to find out the spot of land over which they are on the globe of the earth.

H, the compass, to direct them in their way.

I, the pulleys and ropes, that serve to hoist or furl the sails.

THE SERAPHINE—RULES FOR ITS CONSTRUCTION.

Sir,—I herewith send you the scale required by your correspondent, Mr. Smith, and am yours respectfully,

Sidmouth, April 13, 1843.

N. S. HEINEKEN.

	Length.	Breadth.	Thickness at free end.		Length.	Breadth.
F =	$3\frac{8}{10}$ =	$\frac{2}{10}\ \frac{1}{40}$	$=\frac{5}{100}$	C =	$1\frac{7}{10}\ \frac{1}{20}$	
F sharp =	$3\frac{7}{10}$			C sharp =	$1\frac{7}{10}$	
G =	$3\frac{6}{10}$			D =	$1\frac{7}{10}$	
G sharp =	$3\frac{5}{10}$			Dsharp =	$1\frac{6}{10}\ \frac{1}{20}$	
A =	$3\frac{4}{10}\ \frac{1}{20}$			E =	$1\frac{6}{10}$	
A sharp =	$3\frac{4}{10}$			F =	$1\frac{6}{10}$ =	$\frac{1}{10}\ \frac{1}{40}$
B =	$3\frac{3}{10}$			F sharp =	$1\frac{5}{10}\ \frac{1}{20}$	
C =	$3\frac{2}{10}$			G =	$1\frac{5}{10}$	
C sharp =	$3\frac{1}{10}\ \frac{1}{20}$			Gsharp =	$1\frac{4}{10}\ \frac{1}{20}$	
D =	$3\frac{1}{20}$			A =	$1\frac{4}{10}$	
Dsharp =	$2\frac{9}{10}\ \frac{1}{20}$			A sharp =	$1\frac{3}{10}\ \frac{1}{20}$	
E =	$2\frac{9}{10}$			B =	$1\frac{3}{10}$	
F =	$2\frac{8}{10}$ =	$\frac{2}{10}$ =	$\frac{4}{100}$	C =	$1\frac{2}{10}\ \frac{1}{20}$	
F sharp =	$2\frac{7}{10}$			C sharp =	$1\frac{2}{10}$	
G =	$2\frac{6}{10}\ \frac{1}{20}$			D =	$1\frac{1}{10}\ \frac{1}{20}$	
G sharp =	$2\frac{6}{10}$			Dsharp =	$1\frac{1}{10}$	
A =	$2\frac{5}{10}\ \frac{1}{20}$			E =	$1\frac{1}{10}$	
A sharp =	$2\frac{5}{10}$			F =	$1\frac{1}{20}$ =	$\frac{1}{10}$
B =	$2\frac{4}{10}\ \frac{1}{20}$			F sharp =	1	
C =	$2\frac{4}{10}$			G =	1	
C sharp =	$2\frac{3}{10}\ \frac{1}{20}$			G sharp =	$\frac{9}{10}\ \frac{1}{20}$	
D =	$2\frac{3}{10}$			A =	$\frac{9}{10}$	
Dsharp =	$2\frac{2}{10}$			A sharp =	$\frac{8}{10}\ \frac{1}{20}$	
E =	$2\frac{1}{10}\ \frac{1}{20}$			B =	$\frac{8}{10}\ \frac{1}{20}$	
F =	$2\frac{1}{10}$ =	$\frac{1}{10}\ \frac{3}{40}$	$=\frac{3}{100}$	C =	$\frac{8}{10}$	
F sharp =	$2\frac{1}{20}$			C sharp =	$\frac{7}{10}\ \frac{1}{20}$	
G =	2			D =	$\frac{7}{10}$	
Gsharp =	$1\frac{9}{10}\ \frac{1}{20}$			Dsharp =	$\frac{6}{10}\ \frac{1}{20}$	
A =	$1\frac{9}{10}$			E =	$\frac{6}{10}\ \frac{1}{40}$	
A sharp =	$1\frac{8}{10}\ \frac{1}{20}$			F =	$\frac{6}{10}$ =	$\frac{3}{40}$
B =	$1\frac{8}{10}$					

The above scale will give the length and width of the apertures in the plates of the seraphine, and the tongues must be made accordingly. They of course

will *be longer*, because they are to be fixed to the plates by a metal bridge having two screws to screw it down upon the end of the tongue: I have only given the width at each octave, as Mr. Smith can diminish the intermediate tongues accordingly. The thickness at the *free* end, that is, the thickness of the end of the tongue, I have given for three F.'s—after this, for some distance, the tongues, become of nearly equal thickness at both ends; afterwards, the *free* end becomes the thickest, just reversing the former order; and at the higher notes the *free* end is as thin as paper, the other being thick in proportion. This Mr. Smith will discover when he tunes the tongues. To *flatten*, file or scrape towards the *fixed* end; to *sharpen*, at the *free* end. To ascertain the thickness of the tongues, your correspondent would find an angular gauge very useful. It is the same in construction as the gauges for harp strings. Let the opening be $\frac{1}{10}$th of an inch, the length 1 inch be divided into tenths, and the gauge required will be made. The *tone* of the instrument will in a great measure depend upon the distance at which the tongues are set from the plates. If too great, it will be harsh, metallic and slow. If too near, dull, and *this*, experiment will show. One great difficulty is to obtain an even quality of tone, or what the organ builders would term "equal voicing." I should advise your correspondent to have his wind-chest large. If too small, the vibration of the lower notes will affect the higher. Let him also make his bellows large, for the same reason, and for ease in blowing. With a heavy weight upon the bellows, say 25 lbs., the instrument will speak quicker, and have a rounder quality of tone, than with a lighter weight; but if the tongues are not strong in proportion, they will be liable to frequent breakages. A lighter wind, say 15 lbs., and thinner tongues, will give a soft, delicate tone, of the oboe quality; and if the tongues are well adjusted, they will speak quick also. The dimensions of the boxes or apertures above the tongues also influence the tone: with a large box, &c., the tone is rounder than with a smaller, but these ought to be proportioned to the tongues, that the enclosed air may correspond in its vibrations. If your correspondent should visit London, I would advise him to call on Mr. Myers, the patentee of the Æolophon, 83, Charlotte-street, Fitzroy-square, from whom I doubt not but that he will receive every attention, and who will, if he require it, supply him with an excellent instrument of that description. Should he visit York, he will hear excellent seraphines, upon an *original construction*, at Mr. Peckstone's, organ-builder, &c. In quality of tone and freedom of speaking, these surpass any I have yet heard: they are, moreover, reasonable in price, and well put out of hand. If I can afford Mr. Smith, or any other amateur, further information, I shall be happy to do so.

Yours, &c.,

N. S. Heineken.

P.S.—I should advise your correspondent to take off, slightly, the sharp edges of the tongues, by draw-filing or otherwise, and he will find the tone improved, as well as the chance of jarring against the sides of the apertures diminished.

INSTITUTION OF CIVIL ENGINEERS.

MINUTES OF PROCEEDINGS—SESSION 1843.

February 7.

The discussion on the comparative loss by Friction, in beam and direct-action Steam Engines, concluded from p. 342.

In opposition, however, to these stood the experiments of Professor Vince, of Cambridge,* which led him to the conclusion, that the friction increased in a less ratio than the pressure, and that it was not altogether independent of the area of surface. These experiments were probably conducted with care and accuracy; but it was also probable that equal precision had been used in those which proved the contrary: and if this was allowed, the majority of coinciding experiments might, as in all other cases, be safely received in preference to one dissentient. But, if the particulars of Professor Vince's experiments were examined, many circumstances appeared, which would render them less worthy of regard than others. It was not shown that he experimented upon metals, but that he used pieces of wood, either bare or covered with paper; and the experiments were on a small scale, the moving bodies being at the utmost a few ounces weight: while Coulomb, Rennie, and Morin, had extended their trials to all kinds of materials,

* Phil. Trans., 1785, p. 165.

and had used considerable weights. Professor Vince himself, although satisfied with the method of conducting his experiments, did not seem equally so with their results, as regarded the influence of surface and pressure, for he had remarked, "that no general rule could be established to determine it, even for the same body." Quotations were then given from Gregory, Brewster, and others, corroborating this view of the inconclusive and unsatisfactory nature of Vince's experiments. The law of the influence of pressure and surface upon friction, was occasionally modified by accidental circumstances, two of which might be noticed, as they had been expressly treated of by Rennie and Morin. 1°. It was only applicable within the limit of pressure which would not injure and abrade the surfaces; for when heating and undue attrition commenced, it was natural that the law would not hold good. Well-constructed machinery, however, was never supposed to pass this limit, and therefore this cause of irregularity might be rejected in calculation. 2°. Another modification was produced by the application of unguents; this was treated of by Mr. Wood,* whose experiments showed, that when unguents were introduced, there was a certain area of bearing surface, proportioned to the weight, which was peculiarly favourable as regarded the loss by friction, but that when this area was preserved, the friction was in strict ratio to the pressure. It could not, however, have been Mr. Wood's intention, from these results, to impugn the applicability of the established general laws to the purposes of calculation, but only to show the existence of modifying circumstances under certain conditions; for the formula he had given† assumed the friction to be as the weight, and had no element in it expressing the area.

Mr. Rennie and M. Morin had also examined the influence of unguents, and had found that their introduction did not materially alter the general laws of friction, but only affected the value of the coefficient, or multiplier, to be used in ascertaining its numerical amount. Having thus brought before the meeting the results of the principal experiments on friction, Mr. Pole concluded by adducing the testimony of writers on mechanics, who, guided by these results, had promulgated the laws deduced from them. He gave quotations from the following authors in corroboration of his views, viz.—Emerson,‡ Playfair,§ Tredgold,|| Barlow,¶ Lardner,* Farey,† De Pambour,‡ Poisson,§ Pratt,|| Whewell,¶ and Moseley.** With the last mentioned author Mr. Pole had taken an opportunity of conversing upon the points in question, and the principles adopted in the paper had received the Professor's full approbation, as corresponding with those made use of in his own treatises.

* Treatise on Railroads, 3rd edit. p. 396, et seq.
† Ibid. p. 355.
‡ Mechanics, 1769. Prop. 62.
§ Outlines of Nat. Phil., 1834, Art. 159.
|| Treatise on Railroads, 1825, p. 46.
¶ Math. Dict., Art. Friction.

Mr. Vignoles thought that great praise was due to Mr. Pole, for the research and mathematical reading exhibited in treating the question of comparative friction. In the former remarks he had made, it was not his intention to impugn the accuracy of the abstract proposition, "that friction was independent of the area of bearing surface," any further than to qualify it in its practical application, with the proviso, "that proper proportions were maintained between the area and the pressure, according to the description of mechanism subjected to friction." He therefore desired to consider the question, as to how far in practice one kind of engine varied from the other in the general amount of friction, and to examine how far the areas of the bearing surfaces were in proportion to the insistent weight, caused either by the strain of any angle, or by the direct weight on any of the journals of the moving parts; this inquiry should precede the abstract mathematical investigation. The friction of different substances would not follow the mathematical rule, unless the due proportion between area and pressure was ascertained and observed; these proportions would be very different in heavy machinery, such as marine steam-engines, and the axles of railway carriages. With these qualifications he agreed with the general propositions laid down by Mr. Pole.

Mr. Murray agreed with Professor Vignoles in thinking that the extent of surface in machines materially affected in practice the amount of the friction. He did not mean to advocate the correctness of Professor Vince's experiments, but he would draw attention to the results quoted by Dr. Gregory,†† in which the difference of Vince's experiments and those of other writers on the subject, was attributed to their not taking into account the cohesion of the bodies experimented upon. Their experiments were made with inclined planes, which were raised

* Library of Useful Knowledge, Mechanics, 3rd Treatise, Art, 7.
† Treatise on the Steam Engine, 1827, p. 60.
‡ Treatise on Locomotive Engines, 1840, chap. viii.
§ Traité de Mécanique, 1833, Art. 456.
|| Mechanical Philosophy, 1836, Art. 118.
¶ The Mechanics of Engineering, 1841, Art. 101.
** Mechanical Principles of Engineering, 1843, Art, 133, and Part 3rd, passim.
†† Gregory's Mechanics, vol. ii. p. 25.

until the bodies began to move, and the amount of friction was then deduced from the angle of inclination that had been given to the plane: from this mode it was contended that no definite laws could be laid down. Mr. Murray acknowledged that on dry surfaces, within certain limits, the amount of friction was not influenced by the extent of surface; but he contended that in practice, as different kinds of unguents were used, the cohesion arising from the impurity and clamminess of these lubricating substances, must be considered and allowed for.

Major-General Pasley said, that when he was quartered at Malta, he tried some experiments on friction, by having a slab of Maltese stone, which resembled the oolite of Bath, rubbed smooth and placed horizontally; other pieces of smooth-faced stone of the same quality, but of different areas, were then attached to a cord, which was weighted and passed over a pulley; the weights, which were just sufficient to give motion to the several pieces of stone, were then noted, and it was found that the area of the surface was not important, the friction being directly in proportion to the insistent weight of the stone. He could therefore corroborate Mr. Pole's propositions.

Mr. Farey considered that Mr. Pole had treated the subject of friction so well, and had selected his authorities in such a manner as to establish his position incontrovertibly; he would therefore only remark, that in collating the friction experiments for his work from Dr. Gregory and others, he had in a measure rejected those of Vince, as being on too small a scale, and not of sufficient importance to rely upon as authority. It must be admitted, that viewing the question practically, there were circumstances which would influence the proposition. If the surface of a journal was so small as to drive out the unguent, or to cut into the lower bearing, the friction would be unduly increased, and the theoretical position would no longer hold good. The use of unguents would not interfere with the general proposition, although in practice, any substance used for lubrication, which, when cold, solidified and became adhesive, might, for a time, produce an increase of friction; this of course would be avoided, but it would not bear upon the general question.

Mr. Rennie corroborated the position assumed by Mr. Pole, "that friction was independent of the extent of the rubbing surface;" his experiments, which had been tried on a large scale, and with various substances, gave uniformily this result, within the limits of abrasion; when that commenced, the bearings heated and there was an end of the theoretical position. The texture also, of the rubbing surfaces altered the condition; for instance, any light body covered with cloth opposed a considerable resistance by the friction of the raised nap; but if the body was weighted, it again came within the limits of the law, because it more nearly resembled hard substances, which alone were considered in theory. Hard and soft woods varied, of course, in the same manner. The friction upon each other of metals of different degrees of hardness, caused in practice, some little variation, but it was so slight, that the rule quoted, might be safely received as correct.

Mr. Davison stated that he sometime ago made several practical experiments with an indicator, constructed by Messrs. Maudslay and Field, for the purpose of ascertaining the power required to drive various kinds of machinery, in Messrs. Truman, Hanbury, Buxton, and Co.'s Brewery. 1st. He found, that an engine which indicated 50 horses' power when fully loaded, showed, after the load and the whole of the machinery was thrown off, 5 horses', or one-tenth of the whole power. 2nd. 190 feet of horizontal, and 80 feet of upright shafting, with 34 bearings, whose superficial area was 3,300 square inches, together with 11 pair of spur and bevel wheels, varying from 2 feet to 9 feet in diameter, required a power equal to 7·85 horses. 3rd. A set of three-throw pumps, 6 inches in diameter, pumping 120 barrels per hour, to a height of 165 feet, = 4·7 horses. By the usual mode of calculation, (viz., 33,000 lbs. lifted one foot high per minute,) it would appear that there was, in this case, friction to the extent of 13 per cent. 4th. A similar set of three-throw pumps, 6 inches in diameter, pumping 160 barrels per hour, to a height of 140 feet, = 6·2 horses. By the same mode of calculation as before, there was here, friction to the amount of 15 per cent. 5th. A set of three-throw pumps, 5 inches in diameter, raising 80 barrels per hour, to a height of 54 feet, = 1 horse. By calculation, as before, the friction amounted to 12½ per cent. 6th. A set of three-throw "starting" pumps, pumping 250 barrels of beer per hour, to a height of 48 feet, = 4·87 horses. By calculation as before, the friction amounted to 15½ per cent. 7th. Two pair of iron rollers and an elevator, grinding and raising 40 quarters of malt per hour, = 8·5 horses. 8th. An ale-mashing machine, made by "Haigh," of Dublin, mashing at the time, 100 quarters of malt, = 5·68 horses. 9th. Two porter-mashing machines, made by "Moreland," mashing at the time, 250 quarters of malt, = 10·8 horses. 10th. 95 feet of horizontal "Archimedes screw," 15 inches diameter, and an elevator, conveying 40 quarters of malt per hour, to a height of 65 feet, = 3·13 horses.

Mr. Davison promised to continue these experiments, and to communicate the results to the Institution.

ENQUIRIES AND ANSWERS TO ENQUIRIES.

SHUTTING CAST STEEL.—Sir,—Having a quantity of worn-out mill-bills, which I should be glad to convert into new ones, I should feel greatly obliged if you or any of your intelligent correspondents would inform me whether there is any process for "shutting" cast-steel? Our smiths, here, say it cannot be done; but I am informed that there is an article which, if used in the way that the smith uses sand, viz., by throwing some of it on the steel while it is being heated, it will have the desired effect. By inserting this inquiry, at your earliest convenience, you will oblige, Sir, your obedient servant, A Subscriber to the Mechanics' Magazine from its commencement.—Isle of Wight, March 25, 1843.

[The following extract from Mr. Holtzapffel's invaluable work on Turning and Mechanical Manipulation will probably supply the information wanted by our correspondent. "It is usual to reserve the cast-steel for those works in which the process of welding is not required, although, of late years, mild cast-steel, or welding cast-steel, containing a smaller proportion of carbon, has been rather extensively used; but, in general, the harder the steel the less easily will it admit of welding, and not unfrequently it is altogether inadmissible. The hard, or harsh varieties of cast-steel are somewhat more manageable: *when fused, borax is used as a defence, instead of sand*, either sprinkled on in powder, or rubbed on in a lump; and cast-steel, otherwise intractable, may be sometimes welded to iron by first heating the iron pretty smartly, then placing the cold steel beside it in the fire, and welding them the moment the steel has acquired its maximum temperature, by which time the iron will be fully up to the welding heat. When both are put into the fire cold alike, the steel is often spoiled before the iron is nearly hot enough; and therefore it is generally usual to heat the iron and steel separately, and only to place them in contact towards the conclusion of the period of getting up the heat. In forging works, either of iron or steel, the *uniformity* of the hammering tends greatly to increase and equalize the strength of each material; and in steel, judicious and equal forging greatly lessens, also, the after risk in hardening. * * * When cast-steel has been spoiled by overheating, it may be partially recovered by four or five re-heatings and quenchings in water, each carried to an extent a little less and less than the first excess; and, lastly, the steel must have a good hammering at the ordinary red heat." A practical worker in steel and iron informed us, lately, that he made use of prussiate of potash for the purpose of welding scraps of cast-steel together, and found it to answer perfectly.—ED. M. M.]

REFLECTION OF THE SUN'S RAYS.—Mr. Editor,—I was, one morning lately, smoking my pipe in the pleasure-ground of my residence, in which there is a large pond surrounded by groves of trees. The sun was shining brilliantly at the time, although concealed from my view by the thick foliage on the trees; its reflection from the water, however, being powerful, I was induced, from curiosity, to apply the lens which I generally carry in my pocket to the same, and, applying its concentrated rays or focus to a lucifer match in my hand, it presently ignited. I have since frequently tried the same experiment, which has been uniformly followed by the same results. It is, therefore, an established fact, that fire may be produced from the shadow or reflection of the sun upon water, from whence there can be no real heat. The principle upon which this is to be accounted for being beyond my present comprehension, I should feel greatly obliged by its being submitted, through the medium of your publication, to the consideration of your numerous and intelligent correspondents; and, with the hope of seeing some elucidatory remarks in some future Number, I am, Sir, very respectfully, &c., J. Francis.—Cranbrook, January 10, 1843.

[Why should it be assumed that there can be no "real heat" reflected from the surface of the water? The fact that the match was ignited seems to prove that there must have been sufficient reflected to produce that effect.——ED. M. M.]

COMPARATIVE LIABILITY OF WROUGHT AND CAST IRON TO CORROSION.—Sir,—You would exceedingly oblige me by stating whether *wrought* iron cold water pipes are more subject to corrosion than *cast* iron ones; and whether there are circumstances under which wrought iron will sooner corrode than cast iron? Yours respectfully, L. M.—March 10, 1843.

[Wrought iron, under all circumstances, except when protected by some coating from air and moisture, corrodes much more rapidly than cast iron.—ED. M. M.]

BISMUTH.—Sir,—Can you refer me to any work where I am likely to find a good description of the metal "*Bismuth*," and the uses to which it is applicable? A Constant Reader.—Southampton-place, Camberwell, March 23, 1843.

[See Dr. Ure's Dictionary, Art. Bismuth. Being brittle, it is seldom, if ever, employed by itself, but on account of its fusing

very readily, it is much used in alloys—such as Newton's and Rose's fusible alloys, pewterer's soft solder, &c.—Ed. M.M.]

Odours.—Sir,—Is it a fact that odours do not pass through glass, and what is the cause? X. P.

[It is a fact; and the cause usually assigned for it (for want of a better) is the close texture of the glass. The subject is, however, one of admitted difficulty, and involved in some obscurity.—Ed. M. M.]

Fall of Bodies.—Sir,—Will you be kind enough to supply a solution of the following question? Suppose a vessel moving at the rate of 100 miles per hour, with a perpendicular mast 100 yards high, and a 5 lb. iron ball were released from the top of that mast, would it alight on the deck at the same distance from the centre of the bottom of the mast as it was released from at the top? A solution would put an end to a sharp controversy going on here, and much oblige yours respectfully, A Coal Miner.—Oldham, Feb. 20, 1843.

[The ball will alight on the deck, close to the foot of the mast. The reason is, that when released from the top, it partakes of the velocity at which the vessel is going at the time; and during every stage of its descent, still maintains the same onward velocity. As regards the mast and ball, in their relation to each other, it matters not whether the vessel is moving or standing still. On the same principle which governs this case the slack-wire dancer is enabled, while the wire is in full swing, to toss several balls from hand to hand; and the equestrian performer steps from the back of one horse, at full gallop, to the back of another galloping alongside at the same rate of speed.—Ed. M. M.]

Solution of Oxide of Silver in Nitric Acid.—Sir,—Some of your correspondents who are electrotype experimentalists would feel much obliged to your correspondent Mr. Rockline, for a description of the manner of dissolving the oxide of silver in citric acid, described at page 217. I precipitated the oxide in a nitric solution of silver; but this oxide would not dissolve in the citric solution, with or without heat. Is there any peculiar process required for that purpose, or any peculiar oxide of silver required? I am, Sir, A Constant Reader.

Screw-Cutting.—Sir,—Being myself a practical mechanic, I have had numberless opportunities of witnessing a certain phenomenon in screw-cutting, which I cannot account for. If any of your able correspondents could throw any light on the subject, I, as well as many others in a like situation to myself, would feel greatly obliged. Supposing, then, I take two pieces of metal, regardless of length, say, one piece $\frac{3}{4}$ inch diameter, and another $\frac{1}{2}$ inch diameter, on which I wish to cut a *similar* thread, for which purpose I make use of the *same* pair of dies. Now, when this is accomplished, it will be found by inspection that the worms, though cut with the very *same* dies, will not correspond with each other. I have put the question to several in my own line, and have not been able to meet with any satisfactory answer. I am, &c., Light.—Southwark, April 24.

Blue Ink.—How can I make a *permanent blue ink* at a cheap rate? I have tried many recipes, but cannot prevent precipitation. J. J. Jones.—City-road, April 6, 1843.

NEW PUBLICATIONS ON THE ARTS AND SCIENCES PUBLISHED IN MARCH AND APRIL, 1843.

Historical Sketch of the Progress of Pharmacy in Great Britain, from the time of its Partial Separation from the Practice of Medicine until the Establishment of the Pharmaceutical Society. By Jacob Bell. 1s. 6d.

Practical Bee-keeper; or, Concise and Plain Instructions for the Management of Bees and Hives. By John Milton. 4s. 6d.

The Temple Church: an Account of its Restoration and Repairs. By William Burge, Esq., of the Inner Temple, one of Her Majesty's Counsel. 3s. 6d.

Rural Chemistry. By Edward Solly, Esq., jun., F.R.S., Experimental Chemist to the Horticultural Society of London, and Lecturer on Chemistry at the Royal Institution. 4s. 6d.

The Hand book of Chemistry. By W. Raleigh Baxter, LL.D., Lecturer on Materia Medica and Pharmaceutic Chemistry. 2s. 6d.

Suggestions to Ironmasters, on Increasing the Demand for Iron; also, to the Ironmasters of Staffordshire, on Competing with those of Scotland and Wales. By F. P. Mackelcan, C.E. 1s. 6d.

Machinery—its Tendency; viewed particularly in reference to the Working Classes. By an Artizan. 1s.

The Botanical Looker-out among the Wild Flowers of the Fields, Woods, and Mountains of England and Wales: forming a familiar Monthly Guide for the Collecting Botanist. By Edwin Lees, F.L.S. 7s. 6d.

Transactions of the Royal Irish Academy. Vol. XIX., Part 2.

The present volume contains the following scientific articles:—Rev. Dr. Robinson on the Constant of Refraction, determined by Observations with the Mural Circle of the Armagh Observatory—Dr. Andrews on the Heat developed during the Combination of Acids and Bases—Rev. Dr. Lloyd; Supplement to a Paper on the Mutual Action of Permanent Magnets, considered chiefly in reference to their best Relative Position in an Observatory—George J. Knox, Esq.; Supplementary Researches on the Direction and Mode of Propagation of the Electric Force, and on the Source of Electric Development—Sir William R. Hamilton on Fluctuating Functions—Dr. Macartney on the Minute Structure of the Brain of the Chimpanzee, and of the Human Idiot, compared with that of the Perfect Brain of Man, with some Reflections on the Cerebral Functions.—Sir William R. Hamilton on Equations of the Fifth Degree, and especially on a certain System of Expressions connected with those Equations, which Professor Badano has lately proposed.—Sir David Brewster on the Compensations of Polarized Light, with the Description of a Polarimeter, for Measuring Degrees of Polarization.—Dr. Andrews

on the Heat developed during the Formation of the Metallic Compounds of Chlorine, Bromine, and Iodine.

The Emigrant's Hand-book of Facts concerning Canada, New Zealand, Australia, Cape of Good Hope, &c., with the relative advantages each of the colonies offers for emigration, and practical advice for intending emigrants. By Samuel Butler, Esq. With correct maps of Canada and New Zealand.

A remarkably cheap compendium of the sort of information most wanted by intending emigrants; drawn from the most authentic sources, and compiled with care and discrimination.

A Drawing Book, containing Elementary Instructions in Drawing, and illustrating the Principles of Design as applied to Art. No. V. Price 3*s*. 6*d*.

This is a serial work, produced under the superintendance of the Government Council of the School of Design, and in every respect worthy of the high sanction under which it is published. The five numbers which have appeared—each containing 15 sheets, with descriptive letterpress—are confined entirely to outline drawing. The next three which are to come are to be devoted to shadowing.

Reports and Notes of Cases on Letters Patent for Inventions. By Thomas Webster, Esq., barrister-at-law. Part III.

Mr. Webster is adding greatly by the present publication to the obligations he has already conferred on patentees, and all others interested in patents. It is by far the best collection which has yet appeared. The present Part contains some important cases on the confirmation and prolongation of letters patent.

Magnetical Advertisements, or Diverse Pertinent Observations, and approved Experiments concerning the nature and property of the Loadstone. By William Barlowe. A new edition, with notes, by William Sturgeon.

A Treatise on Astronomy, displaying the Arithmetical Architecture of the Solar System. By E. Henderson, LL.D. Second edition, enlarged, and embellished with numerous engravings.

Periodicals devoted to the Arts and Sciences.

The London, Edinburgh, and Dublin Philosophical Magazine (being a continuation of Tilloch's Philosophical Magazine, Nicholson's Journal, and Thomson's Annals of Philosophy). By Sir David Brewster, Richard Taylor, F.S.A., Richard Phillips, F.R.S., and Robert Kane, M.D. Third series. Nos. 144 and 145. 2s. 6d.

The Edinburgh New Philosophical Journal. Conducted by Professor Jameson. Nos. 67 and 68. 7s. 6d.

Among the articles in this Number the most interesting to mechanical readers is one by Mr. Sang, on Registering the Force of a Driving-Belt, and another, by Professor Traill, on the Use of Granite for Ornamental Purposes.

The Civil Engineer and Architect's Journal, Nos. 66 and 67. 1s. 6d.

Annals of Chemistry and Practical Pharmacy. Nos. 16 and 17.

The Pharmaceutical Journal and Transactions. Edited by Jacob Bell. No. XXII., with an Extra sheet. 1s.

The London Journal (Newton's). Nos. 135 and 136. 2s. 6d.

The Repertory of Patent Inventions. Enlarged series. Nos. 3 and 4.

No. 3. contains, besides the usual quantity of specification matter, a verbatim report of a very interesting lecture lately delivered by Professor Faraday at the Royal Institution.

The Artist's and Amateur's Magazine; a work devoted to the Interests of the Arts of Design and the Cultivation of Taste. Edited by E. V. Rippingille. No. 1.

The principal object of this work is "to open an efficient source of information on the subject of the Fine Arts, Painting, Sculpture, and Architecture, and thus to attempt to reform, cultivate, and refine the public taste."

The Practical Mechanics and Engineer's Magazine. (Glasgow.) Parts 18 and 19. 8d.

The Builder. Part I.; including Nos. 1 to 7, inclusive. 1s. 8½d.

PENDULUM ESCAPEMENTS.

Sir,—Your correspondent W. B. Hunt would find some practical difficulties in applying the escapement, as described by him in your Magazine of April 8, page 280, arising from the necessary delicacy of the action between the discharging pallet and the detent.

I have already surmounted that difficulty, and have applied the escapement with good effect to a clock now under trial at Sir James South's observatory; and should the performance continue favourable, I shall have much pleasure in laying a description before the public.

I am, Sir,

Your obedient servant,

James Shearer.

23, Devonshire-street, Queen-square.
April 16, 1843.

MR. PHILLIPS'S AERODIPHROS, OR AERIAL CARRIER.

Our readers may have noticed repeated advertisements in the newspapers, during the last fortnight, announcing that Mr. W. H. Phillips, of 41, Bloomsbury-square, had invented an aerial carriage, with which he would make "an actual transit, or flight," on the 25th instant, (Tuesday last,) after which, but not till then, he would look for some reward from the public. Less distrustful than Mr. Baddeley and Mr. Charnock, he was willing to demonstrate before the whole world the perfect practicability of the thing, and then to trust to national gratitude for the rest. The 25th arrived, but alas! no ascent. From the following apologetical notice, however, which appeared on the morning of the 25th, it will be seen that the ascent is delayed for a short time only. Ere long, it seems, it is quite certain to take place!

"Aerial Carriage.—W. H. Phillips begs to inform the public, the ascent of the Aerodiphros will not take place on the 25th instant, as was intended; but a short delay only will occur in the fulfilment of the inventor's promises to the public.—41, Bloomsbury-square."

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 25TH OF MARCH AND THE 25TH OF APRIL, 1843.

Nicholas Henri Jean Francois, Comte de Crouy, of the Edgware-road, Middlesex, for certain improvements in rotary pumps and rotary steam-engines. March 25: six months.

Robert Faraday, of Wardour-street, Soho, gas-fitter, for improvements in ventilating gas-burners,

and burners for consuming oil, tallow, or other matters. (Being a communication.) March 25; six months.

Sir Samuel Brown, knight, of Blackheath, commander in Her Majesty's navy, for improvements in the construction of breakwaters, and in constructing and erecting lighthouses and beacons, fixed and floating, and in apparatus connected therewith, and also in anchors for mooring the same, which are applicable to ships or vessels. March 27; six months.

John Sylvester, of Great Russell-street, Middlesex, engineer, for certain improvements in producing ornamental surfaces on or with iron, applicable in the manufacture of stoves and other uses, and for improvements in modifying the transmission of heat. March 28; six months.

Arthur Dunn, of Rotherhithe, soap-boiler, for improvements in treating, purifying, and bleaching fatty matters. March 28; six months.

James Fletcher, foreman at the works of Messrs. W. Collier and Co., engineers, for certain improvements in machinery or apparatus for spinning cotton and other fibrous substances. March 30; six months.

Frank Hills, of Deptford, manufacturing chemist, for certain improvements in steam-boilers or generators, and in locomotive carriages. March 30; six months.

Paul Prevost Brouillet, of Hadley, Middlesex, gentleman, for certain improvements in apparatus for warming apartments. March 30; six months.

John Aston, of Birmingham, and William Elliott, of the same place, button manufacturers, for improvements in the manufacture of covered buttons. April 4; two months.

Joseph Browne Wilkes, of Chesterfield Park, Essex, esq., for improvements in treating oils obtained from certain vegetable matters. April 4 six months.

George Johnston Young, of Bostock-street, Old Gravel-lane, Wapping, engineer, for improvements in the construction of capstans. April 5; six months.

Edwin Whele, of Walsall, Stafford, for an improvement or improvements in machinery for preparing wicks used in the making of candles. April 6; six months.

James Boydell, junior, of Oak Farm iron-works, near Dudley, iron-master, for improvements in manufacturing bars of iron with other metals. April 7; six months.

Robert Hawthorne and William Hawthorne, of the town of Newcastle-on-Tyne, civil engineers, for certain improvements in locomotive engines, parts of which are applicable to other steam-engines. April 7; six months.

John Michell, of Calenick, Cornwall, for improvements in extracting copper, iron, lead, bismuth, and other metals or minerals from tin ore. April 11; six months.

James Napier, of Hoxton, Middlesex, dyer, for improvements in preparing or treating fabrics made of fibrous materials, for covering roofs and the bottoms of ships and vessels, and other surfaces; and for other uses. April 11; six months.

Moses Poole, of Lincoln's-inn, gentleman, for improvements in the manufacture of ornamented lace or net. (Being a communication.) April 11; six months.

Uriah Clarke, of Leicester, dyer, for improvements in the manufacture of narrow elastic and non-elastic fabrics of fibrous materials. April 11; six months.

William Tindall, of Cornhill, ship owner, for certain improvements in the manufacture of candles. April 11; six months.

William Ranwell, of Bowling Green-row, Woolwich, artist, for improvements in machinery or apparatus for registering or indicating the number of persons which enter any description of carriage, house, room, chamber, or place, and also the number of passengers and carriages that pass along a bridge, road, or way. April 13; six months.

William Henry Smith, of Fitzroy-square, civil engineer, for certain improvements in the construction and manufacture of gloves, mitts, and cuffs, and in fastenings for the same, which may be applied to articles of dress generally. April 19; six months.

Charles Tayleur, and James Frederick Dupré, of the Vulcan Foundry, Lancaster, engineers, and Henry Dubs, also of the Vulcan Foundry, engineer, for certain improvements in boilers. April 19; six months.

James Byrom, of Liverpool, engineer, for an improved system of connexion for working the cranks of what are commonly called direct action steam-engines. April 19; six months.

Carl Ludewick Farwig, of Henrietta-street, Covent Garden, tin-plate worker, for certain improvements in gas-meters. April 19; six months.

John George Bodmer, of Manchester, engineer, for certain improvements in locomotive steam-engines and carriages to be used upon railways, in marine engines and vessels, and in the apparatus for propelling the same, and also in stationary engines, and in apparatus to be connected therewith for pumping water, raising bodies, and for blowing or exhausting air. April 20; six months.

John Rand, of Howland-street, Fitzroy-square, artist, for improvements in the manufacture of tin and other soft metal tubes. April 20; six months.

Edward Cobbold, of Melford, Suffolk, master of arts, clerk, for certain improvements in the means of supporting, sustaining, and propelling human and other bodies on and in the water. April 20; six months.

Thomas Oram, of Lewisham, Kent, patent fuel manufacturer, and Ferdinand Charles Warlich, of Cecil-street, gentleman, for improvements in the manufacture of fuel, and in machinery for manufacturing fuel. April 20; six months.

James Johnston, of Willow-park, Greenock, esquire, for improvements in the construction of steam boilers, and machinery for propelling vessels. April 20; six months.

Richard Prosser, of Birmingham, civil engineer, and Job Cutler, of the same place, civil engineer, for improvements in the machinery to be used in manufacturing of pipes and bars, and in the application of such pipes or bars to various purposes April 20; six months.

John M'Tunes, of Liverpool, manufacturing-chemist, for certain improvements in funnels, for conducting liquids into vessels. April 20; six months.

Francois Constant Magloire Viollette, of Leicester-square, Middlesex, late advocate, for improvements for warming the interior of railroad, and other carriages. (Being a communication.) April 22; six months.

Richard Greville Pigot, of Old Cavendish-street, gentleman, for improved apparatus for supporting the human body when immersed in water, for the purpose of preventing drowning. April 25; six months.

James Moon, of Milman-street, Bedford-row, surveyor, for improvements in the manufacture of bricks to be used in the construction of chimneys and flues. April 25; six months.

William Brockedon, of Devonshire-street, Queen's-square, Middlesex, gentleman, for improvements in the manufacture of wadding for fire arms. April 25; six months.

William Mayo, of Lower Clapton, Middlesex, and John Warmington, of Wandsworth-road, Surrey, gentlemen, for improvements in the manufacture of aerated liquors, and on vessels used for containing aerated liquors. (Being a communication.) April 25; six months.

Charles Forster Cotterill, of Walsall, Stafford, merchant, for certain improvements in the progressive manufacture of grain into flour or meal, the whole or part, or parts of which improvements may be applied to the ordinary method of manufacture. April 27; six months.

John Winspear, of Liverpool, ship-smith, for an improved mode of reefing certain sails of ships, and other vessels. April 27; six months.

LONDON: Edited, Printed, and Published by J. C. Robertson, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by W. and A. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1030.] SATURDAY, MAY 6, 1843. [Price 3*d.*

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street.

GRIFFITHS'S PASSENGER PROPELLED CARRIAGE.

Fig. 1.

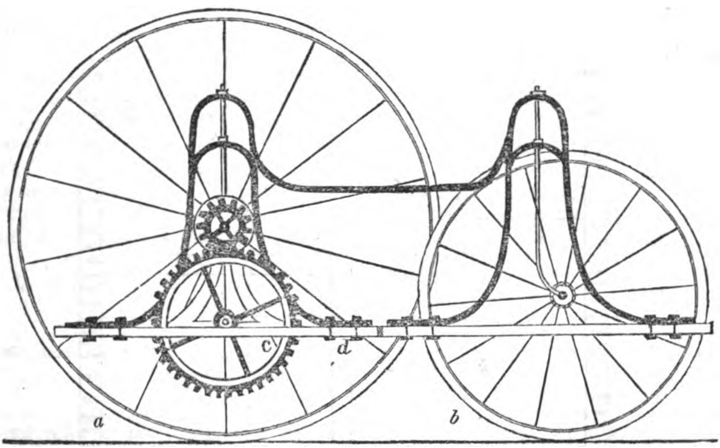
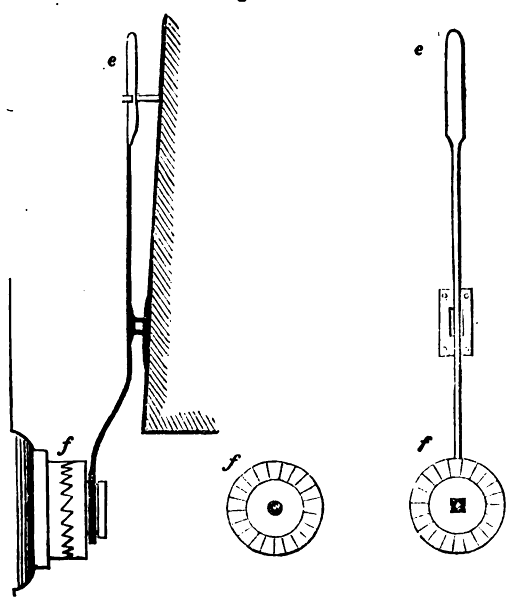


Fig. 2.



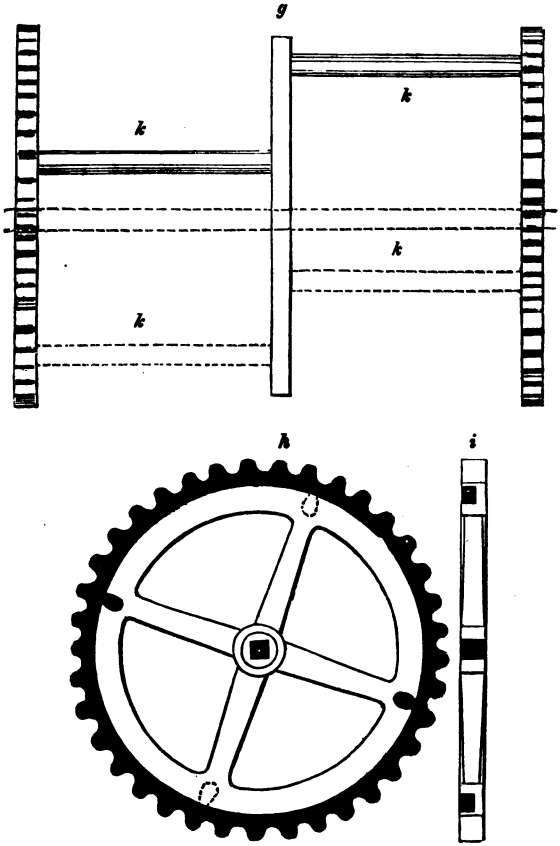
Sir,—Having noticed in your valuable publication several designs for the construction of passenger-propelled carriages, I was induced to devote a considerable time in endeavouring to carry one or other into practical use; but, amongst the many principles applied, none was attended with such advantageous results as that of a continued rotary motion produced by the weight of the body. The accompanying sketch and particulars, (which are the result of eighteen months' practical experience,) are at your service; and should any of your readers wish further particulars, I shall be happy to supply them.

I am, Sir, yours respectfully,

EUSTATIUS W. GRIFFITHS,
Architect and Surveyor.

24, Houghton-street, Strand.

Fig. 3.



Description.

The carriage represented in the accompanying engravings, although not exactly that which I have had in use, is, nevertheless, constructed on the same principle, differing only in the arrangement of a few details. Fig. 1: *a* is one of two driving-wheels, the other being omitted in the figure, for the sake of clearness; *b*, guiding-wheel; *c*, a drum, driving pinions fixed on the main axle; *d*, frame hung on the main axle by iron plates, with turned bearings for two axles. Fig. 2: *e e*, levers employed when turning, to disconnect the inner wheel; *f f f*,

box, one half fixed to the nave of each driving-wheel, the other sliding on the axle acted on by lever *f*. Fig. 3 exhibits the details of the drum: *g*, longitudinal elevation; *h*, end elevation; *i*, section; *k k k k*, cross-bars for placing the feet on as they revolve.

The arrangement for turning, (the difficulty of which is only to be conceived by those who, like myself, have made a practical trial,) is in itself simple, yet most efficient. If we consider, that as the driving-wheels are necessarily fixed to the axle, and that, in turning, the outer wheel performs a greater revolution than the inner, the need of some arrangement to obviate this difficulty will be obvious. The plan I have adopted, (which I was kindly assisted in,) I have found most applicable, as it connects and disconnects of itself.

The principle on which this carriage is worked is based on one of the oldest rules in mechanics, viz., that a man ascending a ladder, and allowing his weight to raise a nearly equal one over a pulley-wheel, will execute double the work, in the same time, that he could by any other means. Probably there may be some objection on account of its putting us in mind of "three weeks' hard labour;" but the motion is particularly slow, as will be found on reference to the proportions—15 revolutions of the drum being necessary, in one minute, to travel at the rate of 10 miles per hour.

The proportions of my original carriage were not so great as those shown in the sketch; but, even with that, I never failed in ascending every hill I wished. And as to speed, I may mention, (though not without regret,) that an accident actually occurred to a person not calculating on its rapid approach, when, although on a level road, it was stated to have been travelling at a railroad pace.

E. W. G.

MATHEMATICAL DEMONSTRATION OF THE PRINCIPLES OF DREDGE'S PATENT IRON BRIDGES. BY THE INVENTOR.

(Concluded from page 239.)

If we refer to the triangle of equilibrium, fig. 7, we shall see by it that the law which regulates the variation of tension in the cord, when an oblique subsidiary force is used, may be shown thus—

Square of the tension in $\mathrm{GH} = \mathrm{OF}^2 = \mathrm{OG}^2 + \mathrm{GF}^2 = \frac{w^2}{16}(\cot.^2 \rho + 1)$

Ditto $\mathrm{HA} = \mathrm{EK}^2 = \mathrm{EG}^2 + \mathrm{KG}^2 = \frac{w^2}{16}\left\{\cot.^2 \rho + 9 + 4(\cot.^2 \rho_o + \cot.\rho \cot.\rho_o\right\} =$

$$\left(\frac{w}{4}\sqrt{\cot.^2 \rho + 1 + 4(\cot.^2 \rho_o + 1 + \cos.(\rho_o - \rho)\sqrt{\cot.^2 \rho_o + 1}\,(\cot.^2 \rho + 1)}\right)^2;$$

now, $(\mathrm{EG}^2 + \mathrm{KG}^2) - (\mathrm{OG}^2 + \mathrm{FG}^2) = \mathrm{FK}^2 + \mathrm{EO}^2 + 2(\mathrm{FK\,FG} + \mathrm{OG}.\mathrm{EO}) =$

$$\frac{w^2}{16}\cot.^2 \rho + 9 + 4(\cot.\rho_o . \cot.\rho + \cot.^2 \rho_o) - \frac{w^2}{16}(\cot.^2 \rho + 1) = \frac{w^2}{4}(2 + \cot.^2 \rho_o + \cot.\rho_o \cot.\rho).$$

So that,

The tension in $\mathrm{GH} = \frac{w}{4}\sqrt{(\cot.^2 \rho + 1)} = \sqrt{(\tfrac{1}{4} w \cot.\rho)^2 + (\tfrac{1}{4} w)^2}$ .... (27).

Ditto $\mathrm{HA} = \frac{w}{4}\sqrt{\cot.^2 \rho + 1 + 4}\,(\&c.) = \sqrt{(\tfrac{1}{4} w \cot.\rho + \tfrac{1}{2} w \cot,\rho_o)^2 + (\tfrac{1}{4} w + \tfrac{1}{2} w)^2}$ (28).

Hence, the square of the tension in H A is greater than the square of the tension in G H, by the square of the weight supported by the subsidiary force C H, plus the square of that weight drawn into the square of the cotangent of H C I, together with twice the rectangle of the weight sustained by the subsidiary force, and the weight supported at G, plus twice the rectangle of the weight sustained by C H, drawn into the cotangent of the angle H C I, by the weight at G drawn into the cotangent of the angle, H G I. In fig. 9 the square of the tension in any link *d e*, exceeds the square of the tension in *e f*, by the

square of the weight supported by the subsidiary force $i\ o$ plus the square of that weight drawn into the square of the cotangent of the angle $e\ o$ I, together with twice the rectangle contained by the weight supported by $e\ o$, and whole amount of weight sustained at f, plus twice the rectangle contained by the weight sustained by the force $e\ o$, drawn into the cotangent of the angle $e\ o$ I, by the whole weight at f, drawn into the cotangent of the angle $e\ f\ x$.

The following table exhibits the relative magnitudes of the tension as they exist in the various links of the cord, A G, fig. 8.

Let w_0, w_1, w_2, &c., to w_{10}, respectively represent the weight acting in the direction of gravity from the point G, t, s, &c. to k, and let the whole amount of weight in the lever I G be = w, then, as before demonstrated, the horizontal thrust = w_o cot. j G k = $\frac{1}{2}\ w$ cot. ϕ; hence, the

Tension in G j = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + w_0^2}$.

Ditto $j\ i$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1)^2}$.

Ditto $i\ h$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2)^2}$.

Ditto $h\ g$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3)^2}$.

Ditto $g\ f$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4)^2}$.

Ditto $f\ e$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5)^2}$.

Ditto $e\ d$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6)^2}$.

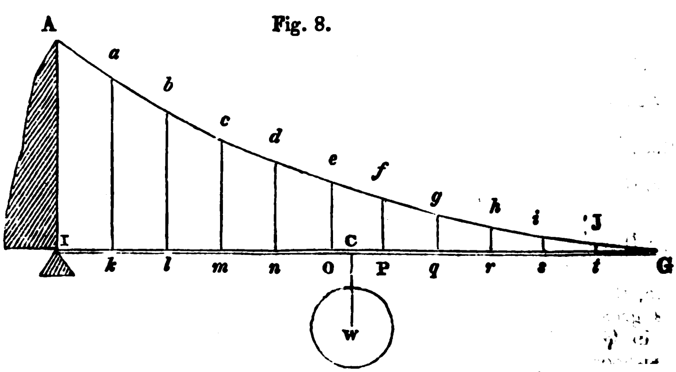
Ditto $d\ c$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7)^2}$.

Ditto $c\ b$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8)^2}$.

Ditto $b\ a$ = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8 + w_9)^2}$.

Ditto a A = $\sqrt{(\frac{1}{2}\ w \text{ cot. } \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8 + w_9 + w_{10})^2}$

Fig. 8.



In fig. 9 the relative amounts of tension in the several parts of the cord, supposing ρ_o, ρ_1, &c. to ρ_9, to be j G I, $i\ s$ I, $k\ r$ I, &c. to $a\ k$ I, are represented by the table as follows :—

Tension in G $j = \sqrt{(w_0 \cot.\ \rho)^2 + w_0^2}$.

Ditto $j\ i = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0)^2 + (w_0 + w_1)^2}$.

Ditto $i\ h = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1)^2 + (w_0 + w_1 + w_2)^2}$

Ditto $h\ g = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_3 \cot.\ \rho_2)^2 + (w_0 + w_1 + w_2 + w_3)^2}$.

Ditto $g\ f = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_0 \cot.\ \rho + w_4 \cot.\ \rho_3)^2 + (w_0 + w_1 + w_2 + w_3 + w_4)^2}$.

Ditto $f\ e = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_3 \cot.\ \rho_2 + w_4 \cot.\ \rho_3 + w_5 \cot.\ \rho_4)^2 + w_0 + w_1 + w_2 + w_3 + w_4 + w_5)^2}$.

Ditto $e\ d = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_3 \cot.\ \rho_2 + w_4 \cot.\ \rho_3 + w_5 \cot.\ \rho_4 + w_6 \cot.\ \rho_5)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6)^2}$.

Ditto $d\ c = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_3 \cot.\ \rho_2 + w_4 \cot.\ \rho_3 + w_5 \cot.\ \rho_4 + w_6 \cot.\ \rho_5 + w_7 \cot.\ \rho_6)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7)^2}$.

Ditto $c\ b = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_2 \cot.\ \rho_2 + w_4 \cot.\ \rho_3 + w_5 \cot.\ \rho_4 + w_6 \cot.\ \rho_5 + w_7 \cot.\ \rho_6 + w_8 \cot.\ \rho_7)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8)^2}$.

Ditto $b\ a = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_3 \cot.\ \rho_2 + w_4 \cot.\ \rho_3 + w_5 \cot.\ \rho_4 + w_6 \cot.\ \rho_5 + w_7 \cot.\ \rho_6 + w_8 \cot.\ \rho_7 + w_9 \cot.\ \rho_8)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8 + w_9)^2}$.

Ditto $a\ A = \sqrt{(w_0 \cot.\ \rho + w_1 \cot.\ \rho_0 + w_2 \cot.\ \rho_1 + w_3 \cot.\ \rho_2 + w_4 \cot.\ \rho_3 + w_5 \cot.\ \rho_4 + w_6 \cot.\ \rho_5 + w_7 \cot.\ \rho_6 + w_8 \cot.\ \rho_7 + w_9 \cot.\ \rho_8 + w_{10} \cot.\ \rho_9)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8 + w_9 + w_{10})^2} = \sqrt{(\tfrac{1}{2} w \cot.\ \phi)^2 + (w_0 + w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 + w_8 + w_9 + w_{10})^2}$.

Therefore, $\underset{0}{w}\cot.\rho + \underset{1}{w}\cot.\underset{0}{\rho} + \underset{2}{w}\cot.\underset{1}{\rho} + \underset{3}{w}\cot.\underset{2}{\rho} + \underset{4}{w}\cot.\underset{3}{\rho} + \underset{5}{w}\cot.\underset{4}{\rho} + \underset{6}{w}\cot.\underset{5}{\rho} + \underset{7}{w}\cot.\underset{6}{\rho} + \underset{8}{w}\cot.\underset{7}{\rho} + \underset{9}{w}\cot.\underset{8}{\rho} + \underset{10}{w}\cot.\underset{9}{\rho}) = (\tfrac{1}{2}\, w \cot.\phi)$; and, consequently, if we substitute the former, instead of the latter, the equations representing the tension in the various parts of the cord, or chain, when vertical subsidiary forces are used, would run thus:—

Tension in G J $= \sqrt{(\underset{0}{w}\cot.\rho + \underset{1}{w}\cot.\underset{0}{\rho} + \underset{2}{w}\cot.\underset{1}{\rho} + \underset{3}{w}\cot.\underset{2}{\rho} + \underset{4}{w}\cot.\underset{3}{\rho} + \underset{5}{w}\cot.\underset{4}{\rho} + \underset{6}{w}\cot.\underset{5}{\rho} + \underset{7}{w}\cot.\underset{6}{\rho} + \underset{8}{w}\cot.\underset{7}{\rho} + \underset{9}{w}\cot.\underset{8}{\rho} + \underset{10}{w}\cot.\underset{9}{\rho})^2 + \underset{0}{w}^2}$.

Ditto $j\, i = \sqrt{(\underset{0}{w}\cot.\rho + \underset{1}{w}\cot.\underset{0}{\rho} + \underset{2}{w}\cot.\underset{1}{\rho} + \underset{3}{w}\cot.\underset{2}{\rho} + \underset{4}{w}\cot.\underset{3}{\rho} + \underset{5}{w}\cot.\underset{4}{\rho} + \underset{6}{w}\cot.\underset{5}{\rho} + \underset{7}{w}\cot.\underset{6}{\rho} + \underset{8}{w}\cot.\underset{7}{\rho} + \underset{9}{w}\cot.\underset{8}{\rho} + \underset{10}{w}\cot.\underset{9}{\rho})^2 + (\underset{0}{w} + w)^2}$.

And, so on. Consequently, the difference of tension between the extreme links *a* A and G *j*. Fig. 8, is only,

$$a\,\mathrm{A} - \mathrm{G}\,j = \sqrt{(\underset{0}{w}\cot.\rho + \underset{1}{w}\cot.\underset{0}{\rho} + \underset{2}{w}\cot.\underset{1}{\rho} + \underset{3}{w}\cot.\underset{2}{\rho} + \underset{4}{w}\cot.\underset{3}{\rho} + \underset{5}{w}\cot.\underset{4}{\rho} + \underset{6}{w}\cot.\underset{5}{\rho} + \underset{7}{w}\cot.\underset{6}{\rho} + \underset{8}{w}\cot.\underset{7}{\rho} + \underset{9}{w}\cot.\underset{8}{\rho} + \underset{10}{w}\cot.\underset{9}{\rho})^2 + (\underset{0}{w} + \underset{1}{w} + \underset{2}{w} + \underset{3}{w} + \underset{4}{w} + \underset{5}{w} + \underset{6}{w} + \underset{7}{w} + \underset{8}{w} + \underset{9}{w} + \underset{10}{w})^2}\, -$$

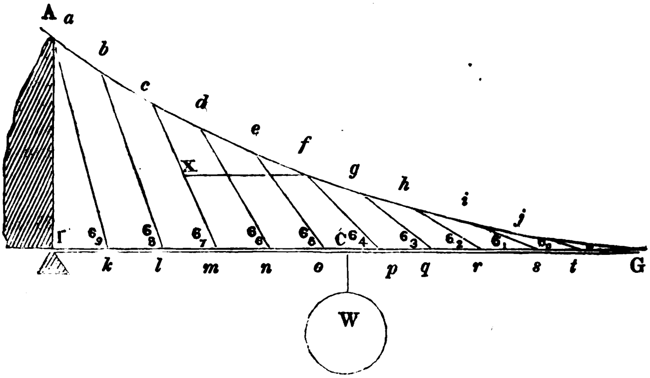
$$\sqrt{(\underset{0}{w}\cot.\rho + \underset{1}{w}\cot.\underset{0}{\rho} + \underset{2}{w}\cot.\underset{1}{\rho} + \underset{3}{w}\cot.\underset{2}{\rho} + \underset{4}{w}\cot.\underset{3}{\rho} + \underset{5}{w}\cot.\underset{4}{\rho} + \underset{6}{w}\cot.\underset{5}{\rho} + \underset{7}{w}\cot.\underset{6}{\rho} + \underset{8}{w}\cot.\underset{7}{\rho} + \underset{9}{w}\cot.\underset{8}{\rho} + \underset{10}{w}\cot.\underset{9}{\rho})^2 + \underset{0}{w}^2},$$

instead of which, the difference between *a* A and G *j*, fig. 9, is:

$$a\,\mathrm{A} - \mathrm{G}\,j = \sqrt{(\underset{0}{w}\cot.\rho + \underset{1}{w}\cot.\underset{0}{\rho} + \underset{2}{w}\cot.\underset{1}{\rho} + \underset{3}{w}\cot.\underset{2}{\rho} + \underset{4}{w}\cot.\underset{3}{\rho} + \underset{5}{w}\cot.\underset{4}{\rho} + \underset{6}{w}\cot.\underset{5}{\rho} + \underset{7}{w}\cot.\underset{6}{\rho} + \underset{8}{w}\cot.\underset{7}{\rho} + \underset{9}{w}\cot.\underset{8}{\rho} + \underset{10}{w}\cot.\underset{9}{\rho})^2 + (\underset{0}{w} + \underset{1}{w} + \underset{2}{w} + \underset{3}{w} + \underset{4}{w} + \underset{5}{w} + \underset{6}{w} + \underset{7}{w} + \underset{8}{w} + \underset{9}{w} + \underset{10}{w})^2} - \sqrt{(\underset{0}{w}\cot.\rho)^2 + \underset{0}{w}^2}.$$

And, even the difference in tension between *a* A and *k a*, fig. 9, is greater considerably than the difference between the extreme links *a* A and G *f*, fig. 8. What has been done in the preceding pages applies to a lever or bracket, supported at one extremity by a fulcrum, or abutment on which it is free, and sustained in equilibrio by one, two, three, or any number of forces acting in different points, and in different directions.

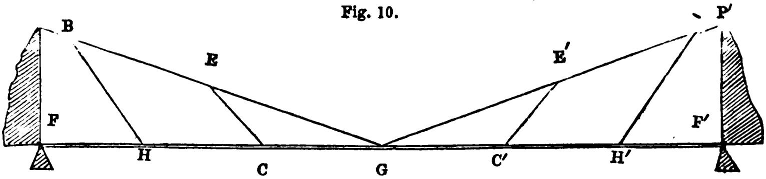
Fig. 9*.



According to this view of the subject, a considerable portion of the equilibrating power depends upon the thrust in the direction of the horizon. But in the case of a bridge which consists of two equal, and similar brackets, placed in opposite directions, and joined together at their remote extremities, these thrusts, or pressures, are wholly neutralized, for whatever effect would arise from the action of any force on one of these levers considered by itself, is, in consequence of the connexion, entirely destroyed by the action of the equal and opposite force similarly applied.

Thus, in fig. 10, F G, and F′ G, are

Fig. 10.



two equal and similar levers placed in opposite positions, and connected at G, in such a manner as to form but one uniform bar resting on its fulcra F and F′; then it is manifest, that if the bar be perfectly rigid, its own weight, and the reaction of the fulcra will constitute an equilibrium, so that there is no thrust against the abutments at F and F′; but if the bar, instead of being supported at the points F and F′, as here supposed, be suspended at its middle point by the cords P′ G and P G, extending in opposite directions, the equilibrium will still obtain; yet there will be no thrust against the abutment in the direction of the bar, for, whatever tendency the force acting on the cord P G may have to draw the bar against the point F, the equal force acting on the cord P′ G has precisely the same tendency to urge it against the opposite point F′, so that their effects are completely destroyed, and the bar remains in a suspended equilibrium. In like manner, if two other forces be applied at the points H and H′, equally distant from F F′, and acting in the direction H B, and H′ B′ making equal angles with the horizon, it is manifest that they will also destroy each other's effects, so that there can be no thrust on the points F and P′ in a horizontal direction.

The same thing may also be shown to take place with regard to the equal and opposite forces acting in the directions

* The engraver has, by mistake, substituted in this cut the figure 6 for the Greek ρ.

C E and C′ E; and, similarly, if any number of forces be applied on opposite sides of the middle point G, the same effects will still be produced: consequently, in the actual construction there is no horizontal thrust to be contemplated, so that the calculation is limited to the tension on the chain and sustaining-bars, together with the vertical pressure upon the towers, a force which is exerted in consequence of the retaining chains in the opposite direction. But if the bar be separated in the point G, the thrusts in the direction of the bar will immediately be brought into action, and their effects estimated after the manner exemplified in the preceding pages.

In conclusion, I will just apply some of the preceding equations by reducing them numerically.

Example.—Let the length of the lever, its weight, and versed sine, be the same as in the previous example, but let a vertical subsidiary cord, C H, be applied at C, as in fig. 8, at the middle of the length of the lever, and suppose one-half of the weight on 50 lbs. be supported by C H, one quarter on 25 lbs. at G, and the remaining 25 lbs. on the fulcrum at I, by equations (14) and (15),

$$\textit{Tension}\ \mathrm{G\,H}=\frac{w}{4}\sqrt{4\cot.^2\phi+1}=25\sqrt{4\times 2{\cdot}904211^2+1}=25\sqrt{34{\cdot}73776}=25\times 5{\cdot}894=147{\cdot}35\ \text{lbs.}$$

$$\textit{Tension in}\ \mathrm{H\,A}-\frac{w}{4}\sqrt{4\cot.^2\phi+9)}=25\sqrt{33{\cdot}73776+9)}=163{\cdot}4\ \text{lbs.}$$

So that 163·4 : *the sectional area* H A : : 147·35 : *the sectional area* G H. Hence, *section* of G H = *the section* of H A × ·901.

In order that each bar may be equally strained, and have a sectional area proportioned to the tension it has to resist, the difference of force in the two bars, M A and G H, is 163·4 − 147·35 = 16·05 lbs.

$$\text{By equation (17), } \tfrac{2}{3}\cot.\ \phi=\tan.\ \mathrm{H\,A\,I}=\frac{2\times 2{\cdot}904211}{3}=1{\cdot}93614=\tan.\ 62^\circ\ 41'\ 2''.$$

Let the bracket remain in every respect the same as in the previous example, excepting only the direction C H of the subsidiary force, which is placed here in an inclined position with respect to the horizon. Let C here occupy the same place as it did in fig. 8, but put A H = 8 feet. The angle H A I is not at all altered by the different arrangement of the subsidiary force, it being here, as before, equal to 62° 41′ 2″.

$$\text{Now, } \mathrm{H\,M}=\mathrm{HA}\sin.\ \mathrm{H\,A\,I}=8\times{\cdot}888487=7{\cdot}1079\ \text{feet.}$$
$$\mathrm{I\,M}=\mathrm{H\,A}\cos.\ \mathrm{H\,A\,I}=8\times{\cdot}458898=3{\cdot}671184\ \text{feet.}$$

By equations (18) and (19),

$$\frac{\mathrm{I\,A}-\mathrm{H\,A}\cos.\ \mathrm{H\,A\,I}}{\mathrm{I\,C}-\mathrm{I\,N}}=\frac{13773-3{\cdot}671184}{40-7{\cdot}1079}={\cdot}307119=\tan.\ 17^\circ\ 3'\ 21'',$$

$$\text{and } \frac{\mathrm{I\,A}-\mathrm{H\,A}\cos.\mathrm{H\,A\,I}}{\mathrm{I\,C}-\mathrm{I\,N}}=\frac{10{\cdot}101816}{12{\cdot}8921}={\cdot}783566=\tan.38^\circ 4' 51''$$

The numeral value of the angle $\rho_{\prime}$ and ρ_{o} being known, we have, according to equations (20), (21), and (22),

$$\textit{Tension}\ \mathrm{G\,H}=\frac{w}{4}\sqrt{\cot.^2\rho+1}=25\sqrt{3{\cdot}2595117^2+1}=25\sqrt{11{\cdot}624386}=85{\cdot}22\ \text{lbs.}$$

$$\textit{Ditto}\quad \mathrm{C\,H}=\frac{w}{2}\sqrt{\cot.^2\rho+1}=50\sqrt{1{\cdot}276228^2+1}=50\sqrt{2{\cdot}628758}=81{\cdot}05\ \text{lbs.}$$

$$\textit{Ditto}\quad \mathrm{H\,A}=\frac{w}{4}\sqrt{\cot.^2\rho+1+4\left(\cot.^2\rho_o+1+\cos.(\rho+\rho_o)\sqrt{\cot.^2\rho+1}\,(\cot.^2\rho_o+1)\right)}=$$

$$25\sqrt{1162{\cdot}4386+4\,(2{\cdot}628738+{\cdot}933424\times 3{\cdot}408\times 1{\cdot}621)}=25\sqrt{42{\cdot}765726}=163{\cdot}4\ \text{lbs.}$$

Now, 163·4 : *the sectional area of* H A : : 85·22 : *the section* G H; or, *section of* G H = *section of* H A × ·521.

So that each bar may be equally powerful in sustaining the bracket. The difference in tension that actually exists between the two bars A H and G H is

$$163 \cdot 4 - 85 \cdot 22 = 78 \cdot 18 \text{ lbs.};$$

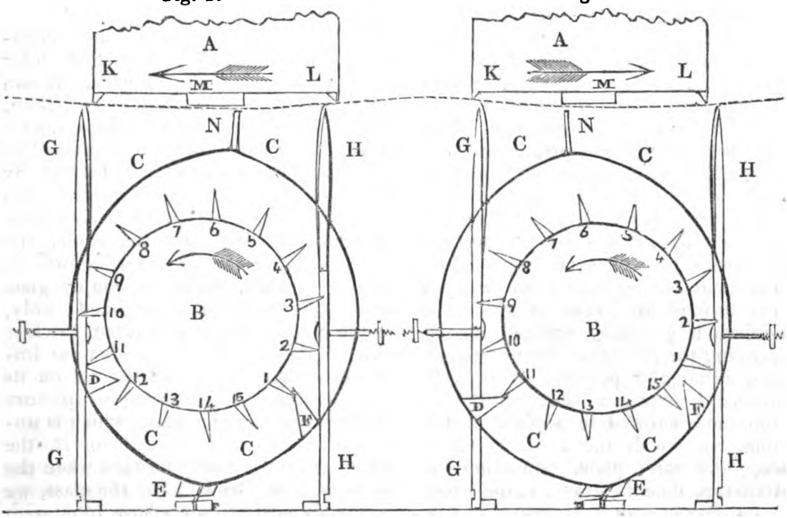
this difference being nearly five times as great as that which obtained by using a vertical subsidiary force.

JAMES DREDGE.

Bath, Feb. 15, 1843.

DOUBLE PENDULUM ESCAPEMENTS.

Fig. 1. Fig. 2.



Sir,—In continuation of the paper on Escapements inserted in your Magazine of the 8th ult., I now proceed to describe a double escapement, which I flatter myself will prove superior to every other. It is represented in the prefixed sketches, figs. 1 and 2, in which the same letters refer to similar parts in each figure.

A, the pendulum. B, the scape-wheel.

C C C C, the lever, of the third order, the fulcrum being at the springs E (see figure 3, former communication, p. 281), the power being alternately applied at the lever pallets D and F, and the resistance at N.

G G, and H H, two detents of the usual construction; K and L discharging pallets, so placed with reference to the detents, that the pallet K shall not touch the detent H, nor the pallet L the detent G.

M, the main pallet, with a groove sufficiently broad cut across it, to admit of its passing and repassing the discharging springs of both detents without touching.

Figure 1 represents the pendulum vibrating to the left and about to draw the locking stud of the detent, G, from the point of tooth 10, which will allow tooth 1 to escape from the lever pallet F, the lever to assume a perpendicular position by means of the fulcrum-springs E, and the head N, to communicate an impulse by striking the main pallet M; the wheel continuing to revolve, tooth 11 falls on the inclined face of the lever-pallet D, and forces the lever to the left, until arrested by tooth 2 falling on the locking stud of the detent H, as shown at figure 2, tooth 11 remaining on the edge of the lever-pallet D, until released by the discharging pallet L, upon the return of the pendulum to the right, striking against the discharging spring of the detent H, and drawing the locking stud from tooth 2.

By removing the detents and discharging pallets, making a slight alteration in the lever pallets, forming the lever head N, in the shape of a fork, and either allowing the fulcrum to remain at E, or by placing it above the scape-wheel, converting the lever into one of the first order, this escapement will correspond

with the lever escapement of a watch, and from its greater simplicity may be made at a less expense; but where extreme accuracy is required, I think it inferior to that just described.

I am not aware of any practical or theoretical objection to the impulse being given at the bottom of the pendulum; but should any exist, these escapements may be applied to any part of the pendulum-rod that may be desired, by having a short bar carrying the discharging and main pallets fixed to the rod at right angles to unlock the scape-wheel and receive the impulse as the pendulum vibrates; and in the construction of an escapement upon these principles, it is indispensable to preserve the relative distance of the different parts under the ordinary variations of temperature; this may easily be attained by placing the clock upon a plate of metal suspended by two or more strong bars from the cock at the back of the frame, to which the pendulum is generally attached, or by suspending the pendulum from the apex of a quadrangular pyramid or obelisk, composed of four bars fastened together at top, and screwed to a plate at the bottom, on which the clock is to be placed—the bars, plate, pendulum-rod and stirrup, detents, lever, scape-wheel and its frame, being all made of the same material, viz., cast steel.

I shall conclude this long account, with observing, that the dead-beat escapement would probably be improved by placing the point of suspension of the pendulum higher than the axis, or centre of motion of the pallets, substituting a forked lever for the crutch, and inserting a stud in the pendulum-rod to unlock the scape-wheel, and receive the impulse as in the lever escapement of a watch; this appears so simple as not to require a figure to explain it, but should any person desire further information, I shall be most happy to afford it, and have only to request, in return, that the result of any trials with escapements upon these principles may be reported.

I am, Sir,

Your most obedient servant,

W. B. Hunt.

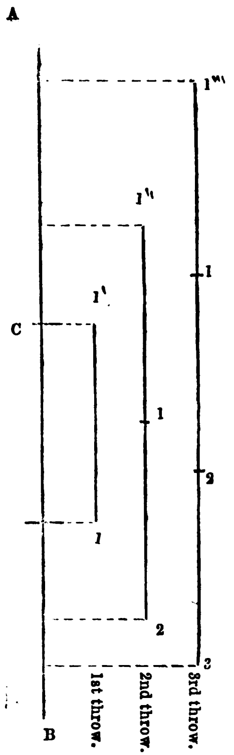
Custom House, April 8, 1843.

WALKER'S WATER ELEVATOR.

Sir,—About a year ago I visited Mr. Walker's manufactory, in Crooked-lane, to see his Water Elevator in action, and afterwards wrote down a few observations illustrative of the view I was led to entertain of its mode of operation, intending to arrange and make them the subject of a communication to your Magazine; but I at first deferred it, and then indefinitely postponed it. Should you not think them now out of date, or unworthy of a place in your pages, they may, possibly, be of some use.

It serves often to assist our conceptions of a thing, to view it first under the most simple form in which it can be presented to us. I would say, then, that a familiar, though perhaps inadequate, illustration of the principle of Mr. Walker's machine may be had, by a person taking a glass of water in his hand, and projecting it forward, and then suddenly drawing back his hand: the water, obeying the first impulse, will be carried forward, while the empty glass alone will come back in the hand; only, as the glass is closed at bottom, the free exit of the water will be somewhat impeded by the pressure of the air on its surface: but if we suppose an aperture in the bottom of the glass, which is unclosed in the act of projecting it, the water will move freely forward when the vessel is drawn back. For the glass, we have only to substitute a long tube, with a moveable bottom or valve, and place it in a pail, or open vessel of water, and move it rapidly up and down, projecting forward, not one, but successive portions of water, and we shall have Mr. Walker's Elevator in its most simple form, sending forth a continuous discharge of water at the upper end.

The effect may be thus explained. The water, by a single throw or upward movement of the tube, is projected, or ascends to a certain height, with a velocity or momentum gradually decreasing, according to the law of bodies projected against gravity. The intensity or force of each upward throw or stroke, and the time between each, are supposed to be constant and uniform; so that each successive portion of water projected would ascend to the same height, and in the same time, if nothing impeded, *i. e.*, if we suppose for a moment, for the sake of illustration, that each portion of water were successively annihilated as it reached its assigned height. With these understood conditions, let the line A B represent the tube, and C the height to which



the water would ascend by a single upward throw, or stroke of the tube; and let C C', an inch on this line, represent the space which the quantity of water projected by a single upstroke would occupy in the tube; then 1' 1 will represent the first projected portion of water, which rises to the height C C', where its momentum would become extinguished, its velocity rapidly diminishing before it reaches that point. But, as all the particles of the column 1' 1 will partake of the same velocity, the *lower* part of the column, at 1, moving with a greatly diminished velocity, will be overtaken and impinged upon, at a point somewhat below C', by the *upper* particles of the next projected portion of water, which, having a velocity or momentum that would carry them up to C, will therefore, at the point of impact, be moving with much greater velocity than the lower particles of 1. By the impact it will communicate part of its own momentum to the first portion, and lose as much itself; the effect of which will be, that the first would be carried to some point higher up, as 1'', before the momentum became extinct, and the lower part, 2, of the two united portions would fall just as much short of reaching C'. But the third projected portion will impinge on the two preceding at a point still lower down in the tube than 2, and while they yet possess a certain amount of momentum; and, as the lower the point of impact the greater will be the velocity and momentum of the impinging body, it will superadd a comparatively greater increment of momentum, which would carry them to a point still relatively higher in the tube, as 1''', before it became extinguished, while the lower end of the column would be at 3, a point still lower than 2. In like manner, the fourth projected portion of water will impinge at a greater advantage than the third, both as having itself a greater momentum, and as impinging on a column having a greater momentum at the point of impact; and so on with the succeeding ones, until the water reaches the top of the tube, and is discharged, when the lower end of the column, the point of impact, will become stationary. In practice this point will be found not far from the bottom of the tube, and nearly coincident with the top of the upward stroke; insomuch that the ultimate action of the instrument would seem at first sight to resolve itself into a series of distinct and rapid acts of direct pressure of the bottom of the tube on the ascending column, rather than into the projection of successive portions of water through an intermediate space. But, in fact, the rapid motions of the tube are so many acts of a percussive or projectile force, whether the water be projected or brought into immediate contact with the ascending column during the upward stroke; and the whole phenomena are more obviously referable to a force of this kind, than to pressure, in its ordinary acceptation, of a slowly applied and continuous force, and implying the counterpressure of the body pressed upon. But counterpressure and momentum are inconsistent with each other, and to the extent in which momentum exists, is counterpressure taken off.

Herein, then, lies the essential distinction between Mr. Walker's elevator and

the lifting-pump. The piston of the latter acts by continuous pressure throughout the upward stroke on the superincumbent column of water, measured from the piston to the point of discharge, and *sustains itself the counterpressure of that column.* The same remark applies also to the forcing-pump, unless it is worked by such a rapid motion as to put and keep in movement the whole column of water forced up by the momentum communicated to it; to which extent, therefore, the counterpressure could be taken off. And, in fact, we have in the fire-engine an instance of the forcing-pump acting in this very way; for it is only in virtue of the momentum communicated to the water by the rapid and vigorous working of the handles, that it is carried with such impetus along the whole length of hose, and then projected with so much force many feet beyond the muzzle.

It follows from what has just been said, that it is not necessary to the action of Mr. Walker's machine, that a motion should be given to the tube, though Mr. W. has adopted this way of working it; for the same effect would follow if the tube were stationary, and motion communicated to a loose piston and valve at the bottom of the tube. And certainly this would be the most facile way of working the single elevator; as we should thereby avoid the incumbrance of having to keep successively raising a great weight of tube; but then it would be destructive of the uses for which the single elevator is intended; for it could no longer be used as a portable hand instrument in the variety of ways it is now capable of being employed. The same objection of the weight of the tubes to be lifted does not apply to the double elevator or stationary machine; as the tubes counterbalance each other, and their united weight is transferred to a certain amount of friction of the axis of oscillation on the gudgeons or supports. There may also be practical considerations not immediately apparent, which may render Mr. W.'s arrangement of making the tubes moveable, preferable to the other method.

I am, &c. &c.

April, 1843. N. N. L.

CHEAP INSTRUMENT FOR MEASURING HORIZONTAL ANGLES.

Sir,—In Mr. Simms's admirable Treatise on Astronomical and Surveying Instruments, it is shown how to divide a circle, or lay off an angle with the beam compasses; in the same way shall the instrument I am now about to describe divide a circle in the field, or find the angular distance between any two objects. The radius chosen by Mr. Simms is 5 inches, mine is 50 inches; therefore, in principle and practice the two instruments are identical: in short, it was Mr. Simms's book suggested to me the construction and use of this instrument. I thank you, Mr. Editor, for your recommendation of this work, in your 22nd volume; indeed, it is no slight benefit conferred by the *Mechanics' Magazine,* that we have an excellent guide in the choice of books.

The instrument is adapted to a table of natural sines, and consists, principally, of two radial arms, that open and close upon a joint, very much like a carpenter's rule; there is a sight-vane set up upon each arm, at the distance of 50 inches from the centre of the joint. The instrument, when in use, is mounted upon three staves stuck fast into the ground; one of these staves has a hole in its top, to receive the shank of the centre sight-vane, and the two forward staves are fitted with short T heads, so as to admit of a little lateral motion in setting the arms, with a simple contrivance for clamping. The forward sight-vanes are very thin and narrow slips of brass, let into the wood with the point of a knife; the centre sight-vane is a piece of sheet brass, with a fine slit in it; to this is riveted a round shank, for the convenience of turning it at right angles with either limb; the joint is put together with a single tongue of sheet brass, inserted into the middle of its thickness.

There is another jointed instrument similar to the above, but rather more slightly made; this has five ten-inch divisions laid off from the centre of the joint upon each limb, and the value assigned to each of these divisions is 1000. This part I use, in connexion with a ten-inch scale, for measuring the chord, or distance between the forward sight vanes, after they are correctly adjusted to the angle between two objects. The scale may be divided to inches and tenths, and let an inch at one end be divided into 100 parts—or 50, if you like, for sake of distinctness—and half a division may be estimated. Now the radius of the instrument being 50, the chord of an arc will

be equal to the natural sine of half that arc, and, as the chord can be measured to four places of decimals, it will be seen, upon inspection of a table of natural sines, that an angle can be measured by this instrument to one minute of a degree.

As a pocket companion to the instrument, I use a set of tables recently published, the joint production of Dr. Gregory and Messrs. Woolhouse and Hann; in which is a table of natural sines to every degree and minute of the quadrant, also tables of the logarithms of numbers, and of the trigonometric functions, quite sufficient for ordinary purposes. It contains, also, numerous other nautical and astronomical tables. In my humble opinion, this is a work which no man of figures, who is aware of its existence, would be without.

Perhaps this instrument is scarcely adapted for a professional man; and, for my own part, I should prefer that correct and beautiful instrument the theodolite; but a common theodolite would cost nine guineas, whereas this instrument can be made (except the scale), by almost any person, for less than that number of shillings. When set up for use, it looks very typical of triangulation, and when the sight vanes are removed—which can be done in an instant—it will tie up very close, presenting a small bundle of straight pieces of deal, weighing altogether 8½ lbs. I have tested it by an ordnance map of my own locality, and find it will make a very close approximation.

Your magazine being an indispensable companion in every Mechanics' Institution in the kingdom, besides having a most extensive individual circulation, I have no doubt but some of your readers would be glad to meet these hints for the construction of a cheap, simple, and efficient instrument. Yours truly,

J. Loose.

Wolverton, April 24, 1843.

BROWN'S PATENT IMPROVED GARDEN-POT.

Mr. Robert Brown of Ewell, Surrey, has lately produced a most decided and important improvement of the common flower pot, by which moisture is so effectually retained, as to prevent the too common injury resulting from the drying up of the delicate fibres of the plants. They are simply made hollow sided (see engraving) so as to hold water, which, by constant, but slow percolation, keeps up a uniform degree of coolness as well as humidity. In the specimens exhibited at the Horticultural Society's rooms, 21, Regent-street, no difference is observable externally, between the ordinary, and the improved garden pot, while its advantages must be obvious to all, particularly when the plants are exposed to the powerful influence of the sun.

Professor Lindley, in the *Gardener's Chronicle* for Dec. 3, 1842, speaks of it in the following commendatory terms:

"We forget what was promised by the voluptuary to him who should procure him a new pleasure; but we know that he who contrives a new instrument of real value in gardening deserves a much better reward—gratitude and support of those who are benefited by it. Such an invention is now before us.

"Mr. Robert Brown, a potter of Ewell, has contrived a garden pot, with close hollow sides, which may be filled with water, or left empty, as circumstances may dictate.

"We regard this as a contrivance of very great value. Every body knows how much plants suffer during summer from the heat and dryness of the pots in which they are growing, and how continually it is required to obviate the inconvenience by placing one pot within another, or by surrounding them with moss, or by plunging them in soil. All this is rendered unnecessary by the contrivance in question; for if the sides of the pot are left empty, the stratum of air contained in them will prevent the earth from becoming heated; and if they are filled with water, the inconvenience of over-watering, on the one hand, or over-drying, on the other, will be prevented in summer, because water will be continually filtering slowly through the inside lining as the roots require it. The latter reason will make it invaluable for striking cuttings, and for window gardens, where it is almost impossible to keep plants duly supplied with moisture, even if the servants entrusted with the duty would give themselves the trouble to attend to it.

"We are quite aware that pots have been already made with double *open* sides; but they are very different, and far less useful,

than those of Mr. Brown with double *closed* sides. We therefore trust that the patentee will receive that patronage from the public which so very useful a contrivance entitles him to."

HIGH PRESSURE STEAM-VESSELS.

Sir,—Not having had an opportunity of reading your valuable Journal for many months, I find in the Notices of No. 980, for May, 1842, an article depreciating the use of high-pressure steam, as employed in that interesting experimental boat, the *Locomotive*, No. 1, which I find emanates from your correspondent "Vulcan," The boiler, of which "Vulcan" complains as being dangerous, is one of the tubular kind used in locomotive engines, and has stood the test of some years' work on one of the foreign railroads, having been returned to this country from its insufficiency of size, engines of a much larger description having been required. Now, sir, "Vulcan" can hardly be ignorant that our railway engineers are in the habit of constructing high-pressure boilers to withstand the internal pressure of 70 or 80lbs. with as great safety as low pressure with 4 or 5lbs. to the inch. Why then should not the like be adopted on board of steam-vessels? It is not in my memory to have heard of the explosion of one of our modern tubular boilers. Has "Vulcan" examined the boiler of *Locomotive* No. 1, and found it defective? If so, his remarks would be worthy of the greatest praise; but if not, why has he attempted to depreciate so worthy an undertaking? I should not have troubled you with this, but hearing that the *Locomotive* is about to renew her duties on the river, I hope to prevent further *unjust* prejudice against her. Yours, &c.,

April 20, 1843. DICQUE.

[Although "Dicque" does not recollect any instance of the explosion of one of our modern tubular boilers, we can help him to several. There was one on the Dublin and Kingstown Railway; another on the Stockton and Darlington; and the other day a very fatal one on the Sheffield and Rotherham, by which several lives were lost. Certainly, however, the instances are, on the whole, very few; and a form of construction which has proved so safe on land, cannot be so excessively dangerous, as apprehended by some, at sea. The chief objection in our opinion to the extension of the high pressure system to steam navigation, is, that on board steam vessels, the passengers are in such close proximity to the boilers, that were an explosion to occur, the destructive consequences must be unavoidably most calamitous; while on railway trains, the engine is so much ahead of the passengers (though not perhaps so much so as it ought to be,) that the chance of injury to life or limb from explosions is comparatively small.—ED. M. M.

THE PILBROW FALLACY—AND ALLEGED DUPLICATION OF FORCE FROM IMPACT.

Sir,—Your readers are much obliged to Mr. Cheverton for the light he has thrown upon the Pilbrow fallacy. On one point only do I feel disposed to differ from him. He seems to consider it to be perfectly established, by the experiments of Bossut, that "the pressure of impact may be greater than that which remotely originates it." Now, what is this but saying, that an effect may be greater than its cause? Du Buat and Smeaton, seeing how impossible this was, sought to reconcile Bossut's experiments with truth, by suggesting that the vein of fluid expands in the act of impact; so that, instead of the pressure of impact being estimated by the area of the orifice of emission, it ought to be estimated by the area of the circle of fluid, (whatever that may be,) which presses immediately against the resisting body, in which case the wonder would cease. You, Sir, again, have a different theory: you think that an increase of pressure at the point of impingement is but a natural consequence of narrowing the channel of emission, (particularly in the way proposed by Mr. Pilbrow), but that there is, on the other hand, such a waste of power from increase of friction, and, in the case of steam, from loss of heat also, that there is on the whole no gain. Which of these theories is the sounder, or whether either of them is just the thing, I do not presume to say; but certainly either of them would account much more rationally for the phenomenon in question, than the supposition of the vein of fluid doubling, *of itself*, the power imparted to it. Accounted for, in some way, it certainly can be, without requiring of

nature an impossibility. Proof there is none, as yet, that there is any doubling of power in the case; though proved it ought surely to be, before we argue about it. We have not even any thing like a *plausible* reason assigned for such a thing taking place. Mr. Pilbrow's hollowing of the resisting body, (his sole sufficient reason after being laughed by you out of the velocity theory with which he started,) but enables that body to hold more of the impinging fluid than it did before, not to add one atom of quantity or force to it; and the notions of his dumb-struck champion, "Scalpel," whether it be his newly-found "force of reversal," or his discovery that velocity is both one thing and another thing at the same time, (so well handled by Mr. Cheverton,) are simply nonsensical. Even Mr. Cheverton's own doctrine of momentum falls far short of the necessity of the case. For, be the momentum of any body projected *horizontally* what it may, the measure of its force is still that which produces or originates it, and no other. The momentum of itself adds nothing; on the contrary, it diminishes in a constantly lessening ratio from the moment of projection. In short, Sir, as you have all along contended, and contended rightly, you can get no more power out of a boiler than there is in it: you may use that power so economically, as to turn nearly every particle of it to account—by working it expansively, for example, to the utmost limits of the expansion theory—or you may waste it enormously and foolishly, as Mr. Pilbrow proposes to do; but you can no more add to it, *from any source external to the boiler itself*, than you can of your own will add an inch to your stature.

I am, Sir, your obedient servant,

PROBE.

London, May 1, 1843.

MR. PILBROW'S THEORY.

Sir,—In the 24th volume of your Magazine, page 453, will be found a communication from me, relative to improvements connected with paddle-wheels, in which there is an account of some experiments not unworthy of notice, with reference to Mr. Pilbrow's theory, and the importance of a novel principle in mechanics, not sufficiently attended to. The account of the experiments was extracted from *Brande's Journal of Science*, for the year 1820, and was stated by him to be taken from some foreign Journal of Science. The experiments had for their object to ascertain the force of a jet of water on two disks of equal area; one of these disks had a plain area, the other had a small rim raised round the edge; the dimensions of the disks were not given, but the fall of water was from 6 to 10 feet. The force of the jet in one experiment, with the plain disk, was 5 pounds; and, with the same head of water, it was 11 pounds on the disk with the rim. In a second experiment, the results were 7 pounds and 15 pounds. A third experiment gave 9 pounds and 20 pounds; that is, the disk with the smooth surface opposed a resistance to the jet of water by one-half less than the disk with the raised rim round the edge. The effect from the introduction of this principle in the above experiments was so considerable, the arrangement so simple, and its applicability of such a general nature, that it is really surprising that more attempts have not been made, before this, to investigate and apply it in practical mechanics. Mr. Pilbrow has the merit of being the first to discover its utility, and your correspondent, "Scalpel," to appreciate its value.

I am, Sir, &c.,

X. Y. Z.

[The experiments in question were made with a *fall* of water, where the force of gravity was superadded to the weight of the falling body, and have no applicability to the case of a fluid column projected horizontally by means of the head pressure of a reservoir of water or steam. The "merit," *quoad hoc*, of Mr. Pilbrow must, therefore, consist in discovering an analogy where there is none; and of "Scalpel," in appreciating the value of that futile discovery.—Ed. M. M.]

MR. HENSON'S FLYING MACHINE—HOW ONE DIFFICULTY MAY BE REMOVED.

Sir,—When I first read an account of the flying machine, an obstacle to its success presented itself to me. I refer to the resistance offered by the wings, in consequence of their oblique position, to the descent of the machine down the inclined plane, which would detract greatly from the initial velocity which might otherwise be attained. I see, by another account that this obstacle

has not been overlooked by the inventor, who has a plan for obviating it. This plan is, to have the wings *furled* until the very instant that the machine is launched into the air, when, by some mechanical contrivance, they are to be suddenly unfurled.

Now, this method seems to me far from being the best that can be devised. It appears to be liable to the following objections. 1. The apparatus must be somewhat complicated, and, consequently, liable to derangement. 2. It must be very difficult of management, in consequence of the necessity of setting it in operation at a certain *instant* of time. The consequence of a failure in either of these two respects would be most disastrous. 3. I doubt very much whether, in the circumstances, it would be possible to unfurl the membranes with sufficient rapidity, or indeed at all, by any power which will be at command. And, 4. The having the wings so constructed as to admit of being furled or unfurled must, I conceive, interfere most materially with the proper distribution of stays, &c. This last consideration seems to me of much importance, as the strain upon the wings will necessarily be very great.

The plan by which I would propose to obviate the difficulty is very simple. Let the hind wheels be larger than the fore wheel, so that the plane of the membrane, in the descent of the machine, might be parallel to the inclined plane. In this case the edge of the membrane will be presented to the air, and will occasion no greater resistance than the simple frame-work would do in the other case. I am, Sir, &c., P.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM MARCH 22, TO APRIL 22, 1843.

Gregory Seale Walters, of Coleman-street, London, merchant, for improvements in the manufacture of chlorine and chlorides, and in obtaining the oxides and peroxides of manganese, in the residuary liquids of such manufacture. (Being a communication from abroad.) Sealed, March 23, 1843.

James Greenshields, of Monteith-row, Glasgow, gentleman, for improvements in the manufacture of compositions for covering roads, streets, and other ways and surfaces, and in rendering fabrics waterproof, to be used for covering buildings, bales, packages, and for other useful purposes. March 23.

Andrew Barclay, engineer and brassfounder, Kilmarnock, Ayr, Scotland, for certain improvements in lustres, chandeliers, pendants and apparatus connected therewith, to be used with gas, oils, and other substances. March 24.

James Fletcher, foreman at the works of Messrs. W. Collier and Co., engineers, of Salford, Lancaster, for certain improvements in machinery or apparatus for spinning cotton and other fibrous substances. March 27.

William Henry James, of St. Martin's-lane, London, civil engineer, for certain improvements in railways and carriage ways, railway and other carriages, and in the modes of propelling the said carriages, parts of which improvements are applicable to the reduction of friction in other machines. March 27

Claude Edward Deutsche, Fricour's Hotel, Saint Martin's-lane, Middlesex, gentleman, for improvements in combining materials to be used for cementing purposes, and for the preventing the passage of fluids, and also for forming or constructing articles from such compositions of materials. (Being a communication from abroad.) March 30.

John Juckes, of Putney, Surrey, gentleman, for improvements in furnaces. March 30.

Thomas Edge, of Great Peter-street, Westminster, gas apparatus manufacturer, for certain improvements in apparatus for measuring gas, water, and other fluids. March 30.

Robert William Sievier, of Henrietta-street, Cavendish-square, Middlesex, gentleman, for certain improvements in looms for weaving, and in the mode or method of producing plain or figured goods or fabrics. April 3.

James Byrom, of Liverpool, Lancaster, engineer, for an improved system of connexion for working the cranks of what are commonly called direct action steam-engines. April 3.

Peter Kagenbusch, of Wetter-on-Rhin, in Westphalia, in the kingdom of Prussia, dyer, now residing in the parish of Lych, in the county of York, in England, for certain improvements in the treatment of the alum roch, or schist, and in the manufacture and application of the products derived therefrom. April 6.

Charles Frederick Guitard, of Birchin-lane, London, notary public, for certain improvements in the construction of railways, and of railway carriages. (Being a communication from abroad.) April 19.

Robert Faraday, of Wardour-street, Soho, Middlesex, gas fitter, for improvements in the construction of railways, and of railway carriages. (Being a communication from abroad.) April 19.

"*The Revenue in Jeopardy from Spurious Chemistry,*" is the title of a very remarkable pamphlet which has made its appearance this week from the pen of Dr. Ure, and cannot fail, on many accounts, to obtain universal attention. We have not room in our present Number to go into details, but the general facts are these:—An article under the name of wood naphtha has been for some time past imported in large quantities into this country from the United States and other foreign countries. A specimen of it having been referred by the Board of Customs to Dr. Ure, he pronounced it to be *alcohol in disguise*—alcohol which, as every one knows, pays a high duty in England, but is untaxed in America, France, &c., where it may be manufactured for two shillings a gallon. Professor Brande, of the Royal Institution, and Professor Graham, of the University College, having been then consulted, both declared that the article contained no alcohol whatever, or, at least, not enough to be of the smallest consequence! Dr. Ure persisted in the correctness of his report; new trials and experiments were made; other chemists were called in; and much amusing correspondence followed between the various parties concerned. The result has been the establishment beyond all doubt of the perfect correctness of Dr. Ure's original analysis, and the extreme erroneousness of the counter-reports of Messrs. Brande and Graham. In the case of one sample, there was but five per cent. of naphtha, and *ninety-five per cent. of strong alcohol!!!* Professor Brande has, with commendable candour, acknowledged that he was in error; but Professor Graham is sulky and silent; while Dr. Ure, with very excusable feelings of exultation, indites this "song of triumph" over both. We shall return to the subject.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1031.] SATURDAY, MAY 13, 1843. [Price 3*d.*

Edited, Printed and Published by J. C. Robertson, No. 166, Fleet-street.

CAPTAIN WOODLEY'S CAPSTAN PADDLE-SAIL AND PADDLES.

Fig. 1.

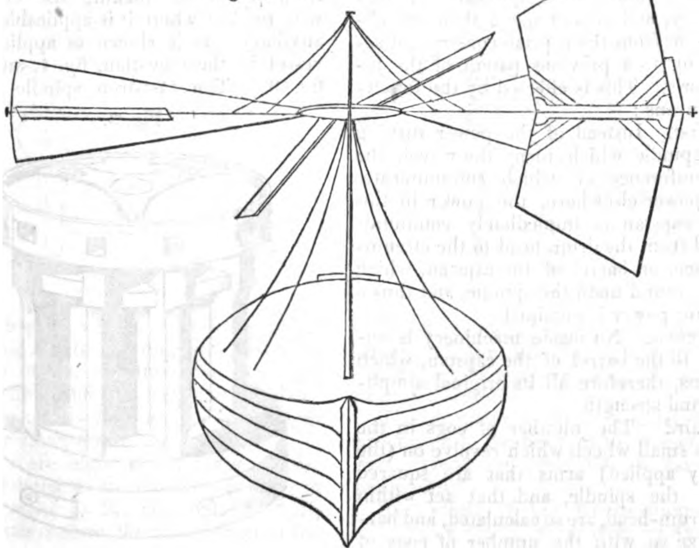
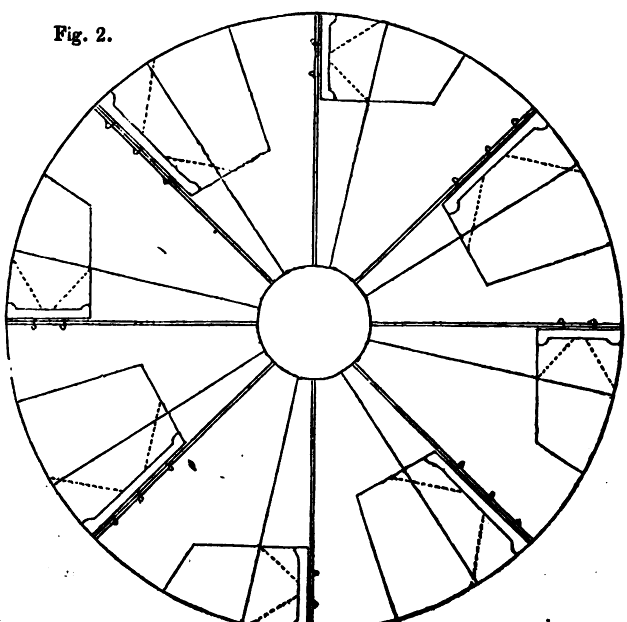


Fig. 2.



DESCRIPTION OF THE PATENT METHOD OF PROPELLING VESSELS BY MEANS OF A CAPSTAN PADDLE-SAIL AND PADDLES, WITH OR WITHOUT THE AID OF STEAM. INVENTED BY CAPTAIN WOODLEY, R. N. BY THE INVENTOR.

[Patent dated July 13, 1839; Specification enrolled, August 13, 1840.]

1. *Of the Capstan.*

The object of the present improvement in ships' capstans is to obtain more power, a more simple application of machinery, and greater speed than are obtainable from the capstan constructed according to a previous patent of the inventor's. This is effected by the following means :—

First. Instead of the power turning the spindle which turns the wheel, the circumference of which communicates the power elsewhere, the power in this new capstan is immediately communicated from the drum-head to the circumference, or barrel of the capstan, which turns round upon the spindle, and thus a greater power is obtained.

Second. No inside machinery is applied to the barrel of the capstan, which retains, therefore all its original simplicity and strength.

Third. The number of cogs in the three small wheels which revolve on (the newly applied) arms that are squared upon the spindle, and that act within the drum-head, are so calculated, and harmonize so with the number of cogs of that wheel, which is squared upon the head of the barrel, as also with those of the great spurwheel, which is immediately within the drum-head, that there is speed in a great measure obtained, combined with power. In this consists the chief merit of the discovery — it being such a combination for power and speed as we have not been hitherto acquainted with in mechanics.

This capstan stands in its ordinary place in ships for the usual purpose of *heaving* up the anchor, and will serve to work the chain pumps. And in a river, or, in the case of a calm, it serves, by means of a band, to turn the spindle of the paddle-sail to be afterwards described. For, unlike the former patent capstan, where it was necessary to walk round four times nearly to get one turn of the barrel, in this capstan the barrel turns twice when the drum-head is hove round once.

Fig. 3 of the accompanying engravings is an elevation of the improved capstan, and fig. 4, a plan.

2. *Of the Capstan Paddle-sail.*

The object of the paddle-sail is for ships to sail steadily at about two points from the wind, making use of steam with paddles where it is applicable, as an auxiliary. It is shown as applied to a vessel in the elevation, fig. 1, and plan, fig. 3. The cast-iron spindle of the

Fig. 3.

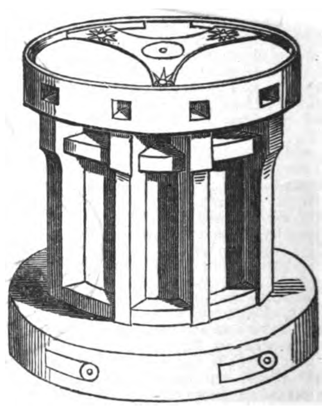
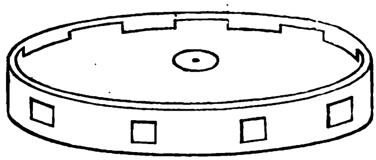


Fig. 4.



wheel stands in the centre of the keel, or, a little abaft it, and the paddles before it, where the submarine paddle is not used; and the spindle is partly squared in order that the brass rim to which the downhauls of the sails are fastened, may slide up and down, except immediately under the truck (or nave), where the spindle travels round within a brass tube, to which the iron stays, or rigging, are affixed.

The truck, or nave, is wood and iron; it is as flat as the eight square holes in it for the reception of the shafts will admit of, and is fixed horizontally on a shoulder on top of the spindle.

The shafts are eight wood or brass

Fig. 5.

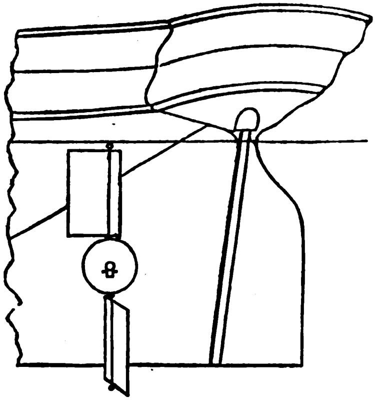
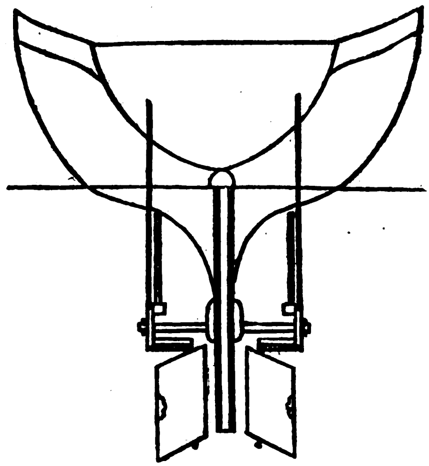


Fig. 6.



iron tubes placed on the nave horizontally, and steadied by four iron rods from the top of the spindle above the nave. The circle round the shafts is thin plate-iron, flat to the wind, or it may be slight rope for small craft.

There are eight slight perpendicular pins fastened at their centres to the rim of the wheel at the end of each shaft, or, a little before them, and bent to the wind to support the sails by means of the gear.

The upper sails are kept up a little by the gear, from the pins, and small brass springs may be attached to it, that the upper sails may fall more flat to the wind.

The sails are eight in number, namely, four large, for fine weather; and four small for stormy; and the eight are set off the wind, at three or four points, and the four go close to it. The part of their frames next the shafts are thin brass plates with hinges, which are confined to the shafts by rings; and the upper and lower parts of the frames of each sail, above and below the shafts, are made of light materials. The sails are in the form of, and stand out horizontally from, the shafts, like butterflies, and are drawn in, and out, upon the shafts as required.

The paddle-sail, which always goes round one way, is so contrived, that, at full speed, the sails may be spilled, and drawn into the nave in a minute when the wheel can be stopped, and the sails taken down.

Below the deck, the spindle turns the spindle of the paddles by means of a crank; or, by a pulley, it turns the submarine paddles.

The diameter of the paddle-sail is in proportion to the beam of the vessel, and may extend on each side as far as a main yard.

The effect of the paddle-propelling sail upon a vessel, as proved by experiment, is, that independently of foremast, bowsprit, and small mizen (which are proposed to be rigged, polacca fashion,) she will keep steadily, with the helm amidships, to either tack, at about two points from the wind, and be propelled fast; but with good steerage way, and nearly head to wind, or quite so with the auxiliary of steam, faster with the paddle sail. Off the wind, assisted by the head square sails, she will be as quick as need be. When becalmed, or in a river, and without steam, with this new patent capstan, the barrel of which revolves twice, when the drum-head is hove round by the bars once, the spindle of the paddle-sail may be turned by means of a band, which will turn the paddles.

Steamers may try the paddle-sail at a trivial expense.

The paddle-sail and paddles will be found useful to any kind of vessels, except in rivers; particularly to those navigating between the tropics, such as the packet steamers. It is well adapted also for fishing boats.

3. *Of the Capstan Paddles.*

The submarine paddle-wheel, to which is fitted the paddle-sail, rotates vertically under the ship's counter, one on each side of what is called the dead wood; or one paddle only may be used placed in the dead wood. They are on the same principles as the paddle-sail, and act in the same way, reversed; with the exception, that one wing is used instead of two, to each shaft. See the explanatory figures, of which fig. 5 is a stern view, and fig. 6 a side view.

The shafts are two in each paddle, one opposite to the other; the one wing to each shaft is so contrived that it collapses and opens when in a straight line with the keel, as the ship gets way at the moment only that it can do so; and by one wing opening the reverse way to this on the opposite side, that propels in a straight line also with the ship's keel. The rapidity of the revolution (though not half of the screw is necessary,) gives the same effect as if only one whole paddle-sail (in four) acted on the water vertically.

The paddles are turned by means of a band from the spindle of the paddle-sail, and either the spindle of the paddles revolves, and the band forms a wheel, in the ship within the counter; or the paddle spindle is a fixture, and the band goes over the ship's stern, and turns a wheel to which the paddles are attached that revolve on the spindle.

THE PRINCIPLES OF AERIAL LOCOMOTION —THE OBJECTIONS TO MR. HENSON'S PLAN EXAMINED.

Sir,—In further prosecution of my attempt to illustrate the principles of aerial locomotion, by means of remarks on the objections made to Mr. Henson's machine, I wish now to call the attention of your readers to three articles, in as many different publications, which, though dissimilar in appearance and results, are founded on the same principle, and that, I believe, an incorrect one.

The first of them appeared in the *Railway Magazine* of the 15th of April, and professes to show that Mr. Henson will require a power of 13,550 horses!!! This result is brought about by assuming, first, that water and fuel for a day's consumption are to be carried in the machine; and, secondly, that all the water is thrown away when it has once been converted into steam, and done its duty: and for these items the writer adds 50,400 lbs. to the 3,000 lbs. assigned by Mr. Henson as the total weight of his machine, *fuel*, *water*, and cargo. Now, Mr. Henson, I believe, never contemplated, or professed a capability of, carrying fuel for an entire day: he has contented himself with proposing to carry what the present state of mechanical science may enable him to carry, and shortening his flights accordingly. As to water, he needs only a very small supply, for waste, since the working water is condensed and used again, without end. The writer of the *Railway Magazine* article quotes *Newton's Journal* as his authority for the details: if he had been cautious, or fortunate enough to consult more correct and complete accounts of the invention, he would have spared himself this blunder.

The two articles referred to form the staple of one in the *Illustrated Polytechnic Review*, in which the erroneous statements of the former are very faithfully and exactly reproduced. It needs, therefore, no separate answer.

Divested, however, of the error I have pointed out, and its consequences, this calculation is found to rest on the same principle as that of the *Athenæum*, April 8; and since the fallacy by which it is vitiated is one of a kind very likely to entrap well-read mechanists, it is important that it should be clearly exposed. The talent and candour of the last-mentioned publication are above my praise; and the good humour of its article on this subject will, I trust, be met in a like spirit.

In my first communication on this subject, (*Mech. Mag.*, No. 1025,) I stated that Mr. Henson's machine, after being started at the requisite velocity, is sustained by the impulse of the air on its inclined under surface; but since this impulse not only sustains, but retards it, a power is required to neutralize the retardation, and thereby to continue the sustentation and the flight. The *Railway Magazine* writer says—"Yes; but the power required for neutralizing the retardation is just equal to that which would hinder the direct fall; and since we know how fast surfaces bearing given loads will fall through the air, we know what power will sustain them;" or, to give his own words, "the power of the

engine to propel the body through the air must be equal to the power of engine necessary to balance the direct fall of the mass." Then appealing to a table of his own for the velocity of fall, he computes therefrom the requisite power.

The *Athenæum* comes to the same conclusion more shortly, by treating the machine as a great umbrella, or a parachute; and, taking the load at two-thirds of a pound to the square foot, concludes by the common theory, that the fall would be 18 feet per second, and the power required to prevent it, 60 horses.*

This view of the subject treats the machine just as it would, if it had no horizontal motion through the air, and herein is its mistake. If this view were correct, no bird could skim as a rook does: it must fall, according to it, at the rate of 18 feet per second, if it be loaded with two-thirds of a pound per square foot; or about 16 feet if loaded, as according to Mr. Bishop, with half a pound per square foot: and doubtless it would do so if it had no progressive motion. Half an hour's walk in the fields is all that is requisite to overturn this position. Rooks and daws will be found to proceed for 10 or 20 seconds together, without the slightest motion of the wings, and with very little apparent descent. To mention the last instances I chanced to observe:—Half-a-dozen of these black-coated aeronauts were gambolling and curvetting on and about the upper branches of a tree in Kensington-gardens; one of them, in rising suddenly to avoid his fellows, nearly lost his horizontal velocity, and had to flap away sharply for a few strokes, to keep himself from falling; after a little more fun, he was again nearly at a stand-still, when two or three beats of the wings set him agoing, and he skimmed away within a few feet of the tops of the trees, not making another stroke until he had passed over two trees, which I found to be about one hundred yards distant from each other; and no perceptible descent had occurred. Now, if he were then travelling at the ordinary rate of the crow, or say 20 miles an hour, his flight of 100 yards must have occupied about 10 seconds; and instead of being, as nearly as I could judge, as far above the tops of the trees as ever, he ought, by the argument of the writers I have quoted, to have been at the foot of them; for, certainly, they are not 100 feet high. A few evenings afterwards, I chanced to cross a favourite field of a flock of these birds, where many instances occurred of much longer skimming flight than that I have described; they were the performances of birds arriving at the field, and at the end of each, when the bird wished to come to the ground, he had to diminish his horizontal velocity by circuitous descent, or to turn himself beak downwards, so as to present the edge of the wings to the air, checking his course when near the ground by regaining his customary position. In all these cases, the descent was very small, so long as the horizontal velocity was preserved. Some of the birds, however, gave me a still better opportunity of judging of the very small amount of the descent, for they skimmed along, for more than a hundred yards together, within less than a yard of the ground, which was that of a very level meadow: I could perceive very little descent, and at the end of the flight the birds got rid of their horizontal speed, either by rising to the height due to it, and then gently descending, or by passing beyond the spot at which they intended to alight, and turning round; or by raising the head and expanding the tail so as to present as large a surface as possible at a large angle to the air in front. It was clear, in every case, that the loss of the horizontal velocity was necessary to enable them to come to the ground. These are observations which any body may easily repeat: I might readily add to them others which differ in appearance, but depend on the same principle; but these are sufficient for my purpose.

Now, here we avoid all question as to the muscular power of the bird; that power is perfectly at rest, and the wings are outstretched and rigid; the living fabric has become strictly a moving body, governed by mechanical principles. But the result does not accord with the proposed theory; the bird should fall 16 feet per second, after attaining the maximum velocity; but it falls scarcely at all. This is surely enough to shake our faith in the conclusions of our friends of the *Railway Magazine*, and the *Athenæum*.

It is important to know something more of this discrepancy; for it is upon the magnitude of the velocity of fall that their adverse deductions are founded;—because with a given surface such a

* Query—is not this printed by mistake for 100 horse power? For $\frac{3000 \times 18 \times 60}{33000} = 98 \cdot 18$.

weight falls so rapidly, it requires such an amount of power to sustain it. If it fell less rapidly it would require less power; if it were in a denser medium, it would fall less rapidly, and, as far as the argument of the *Athenæum* goes, would require less power; if it were supported by a solid body it would require no power at all for its translation, except that required to overcome friction &c.

Let us then trace back the argument by which this velocity of fall is established, and see whether it really applies to the case. It begins with the imaginary case, (which it never leaves,) of a free and single impact of each particle of the fluid, on a surface perpendicular to its path; and it supposes that when the impact is over, the particle as to all further effect, disappears. On this supposition a body loaded with a pound to the square foot, should fall in air of atmospheric density, 29·15 feet per second, and with half that load, 20·61 feet; but the real fall is only, at most, 22 and 16 feet respectively. The body falls as though it were resisted, in manner according to the theory, but by a fluid of greater density.

But this fact, so well calculated to keep true philosophic vigilance in action, is not all. The theory goes on to show that *if we still adhere to the supposition of a single and final effect of each particle*, the force of oblique impact in the direction of the motion of the wind or plane is $= f = \frac{v^2}{500} \sin {}^3 r$; (*Mechanics' Magazine, No.* 1025, p. 261, and the authorities there quoted,) and this representation of its amount allows for the error already discovered. It is in this state of the theory that our authors apply it to this case, and it is precisely against that application that the caution I ventured to suggest at page 262, No. 1025, was directed. Let us see what the theoretical result is worth by comparing it with experimental facts.

The angles with which we have to do are small: Sir G. Cayley says, (*Mechanics' Magazine, No.* 1025, p. 264) that one in ten certainly exceeds that of most birds, and probably one in sixteen is nearer the truth. The first of these corresponds to about 5° 42′, and the second to 3° 35′; the only angle near to these in the experimental table to which I shall have to refer, is that of 5° to which therefore we will confine our attention. This table occurs in Hutton's Dictionary, Art. Resistance, and is copied in *Gregory's Mechanics*, vol. i. p. 563; and, probably in other works. It gives the experimented resistance of the air, to a plane whose area was 32 square inches, set at various angles to its path, and moving with a velocity of 12 feet per second. At 5° it states, that the resistance was ·015 oz.; now the theory above described makes it only

$$\left(\frac{12^2 \times \sin^3 5^\circ \times 16 \times 32}{500 \times 144} = \right) \cdot 000678 \text{ oz.}$$

or but one part in twenty-two of that which it was really found to be. The immediate effect of this resistance on the plane is the same, in that direction, as would be produced by a medium 22 times denser than air, and in such a medium the body would fall, not 16 feet in a second, but $\left(\frac{18}{\sqrt{22}} = \right) 3 \cdot 8$ feet: and the power required, as deduced from these additional considerations, (but according to the principle of the *Athenæum*,) is not 60 or 100 horses, but

$$\left(\frac{\overset{\text{lbs.}}{3000} \times \overset{\text{feet.}}{3 \cdot 8} \times 60}{33000} = \right) 20 \cdot 7 \text{ horses-}$$

power. This conclusion serves to show that the "answer" given by the writer in the *Athenæum* is not to be relied on; and it may further suggest, though but inexactly, the cause of the very small descent of birds while skimming.

But the manner in which the subject is put in the *Railway Magazine* allows of a rejoinder to this effect:—"Suppose the medium be so increased in density, and the direct fall so much retarded, it is still the same condensed medium, acting with a correspondingly increased effect, which resists the flight, as well as sustains the body, and therefore our conclusion still holds good, that the power of the engine to propel the body through the air must be equal to the power of the engine necessary to balance the direct fall of the mass." To invalidate this conclusion, it is sufficient for the present to observe, that it depends for its truth on the assumption, that the fluid medium is in such a condition as to act with equal force in every direction; now with a *dynamical* disturbance so violent as to increase its pressure in one direction twenty or thirty times, we have no right

to assume any such thing, until we know something of the mode in which that increase of pressure is produced, and with what other effects it is attended. It may strengthen our doubts of the correctness of this assumption to remember, that the whole theory is based on the supposition that each particle disappears immediately after the impact, and that in the case of very oblique impulses it is evident that, on being reflected from the surface, the particles which struck in its anterior portion must greatly interfere with the action of those which impinge on the hinder part; but in what manner or to what effect is not yet shown.

It is then, perhaps, not too much to say, that neither of these writers has succeeded in showing the impossibility of Mr. Henson's success. And here let me observe, that my position is not that that inventor absolutely will succeed, (although I think it highly probable that he will,) but that we have not, in our existing science, the means, when fairly applied, of proving that he will not; and I trust the considerations adduced above will show, that if he has not the support of absolute demonstration, he has in his favour a degree of probability more than sufficient to justify the prudence both of his own perseverance, and of the expenditure and confidence of his supporters.

May 10th, 1843. L.L.

P. S. I hope soon, perhaps next week, to submit to your readers, with your permission, an examination of M. Chabrier's theory of flight which was brought before them by Mr. Bishop, and is given at considerable length in that gentleman's able article on Motion in Todd's "Cyclopedia of Anatomy and Physiology."

The Aerial scheme is honoured with no less than three articles in the last number of the *Artizan;* of which the greater part of two is occupied with replying to me. My only answer is, to request such persons as may feel sufficient interest in the subject, to read all the original articles over again. As to correcting the mistakes of the *Artizan* in this matter, as fast as they occur, it is evidently a hopeless task.

Your correspondent, "P.," will be glad to learn that Mr. Henson adopts a device by which the wings are made parallel to the plane, except near the foot of it, where the front edge of the wings is lifted, so as to produce the requisite angle of elevation. L. L.

MR. PILBROW'S "DISCOVERY."

Sir,—It being the best and shortest mode of deciding on a disputed case in science, to show at once wherein lies the truth, and then prove the same by principles and laws which are undeniably natural, I shall follow the precept, by admitting the possibility of the steam at the nozzle, or rather beyond the nozzle, of the discharging-pipe having a greater force than it had when within the boiler. And, for this reason, that that which constitutes the force of steam is not derived from either the water within, or the fire beneath the boiler, but from the medium of space which exists every where, and into all things has more or less free access; and because, also, there is the probability that the steam, in passing through the "three-quarters of an inch space," may acquire, from the air in that space, additional increments of the said medium, which is the cause of all physical force in the entire system of nature. But, as my Philosophy* is not the Newtonian, by the greater portion of which all are misled —for it is not the philosophy of nature, —it is necessary that natural principles, and circumstances in support of advanced principles, should be stated, in order that others may understand by what steps the conclusion is arrived at, that, in particular instances, the force of steam may be greater at a distance from, than within the boiler.

All bodies being formed of inert, unalterable atoms, possess no force, or means of force, within themselves, and can experience no change, bodily or atomic, but of a local nature, which implies motion, which is the effect of physical impulse. Motion being the only physical effect, there must be a cause as universal as motion; and the motion of the inert bodies of the planets indicates, that, as nothing short of a medium occupying space can retain the whole host of heavenly bodies in endless motion, so in the impulsive pressure of this medium consists the sole physical force of nature. One cause of forcible motion is alone required, such cause being universal, for the production of the common effect, motion; having in mind, that effect means the consequence of impulse pre-

* The "Philosophy" of our esteemed correspondent, Mr. Pasley, forms the subject of an 8vo. volume, which he published in 1836, and which it is impossible to read without high respect for the ability of the writer, however we may feel compelled to dissent from his conclusions. [Ed. M.M.]

vious to result. And were all the atoms of terrestrial matter spherical, and the smallest interstices formed by atomic aggregation, larger than the atoms of the medium of space, then would the medium of space be continuous from without to the interior of even the densest bodies, as is the surrounding water with the water in the case of a submerged sponge. And then would the force of the general pressure externally exerted act on atoms, to collapse them together as solid bodies; afterwards to contract them, or increase their density; and, when exerted internally, to expand bodies and convert them into air or vapour, according to the medium in which each may be circumstanced. Thus, from the universal fundamental principle, *inertia*—of which Newtonians make an *innate force*—is deducible consistently, and it may be said demonstrated, that the pressure of the medium of space is the physical cause of every physical effect—that is, of all motion.

While it is imagined that bodies have heat communicated to them by fire, the contrary is the fact universally. All bodies suffer loss by fire, and heat has no physical existence. Heat is but a sensation, which indicates that its remote cause, the fire, is not hot; as the sensation sound indicates the fact, that a bell neither includes nor makes material sound. The promoting cause of a sensation has no similitude with the sensation. Heat is one of our feelings. The natural fact, then, is, that all bodies suffer loss by means of fire: paper, candles, all kinds of fuel, the iron bars of stoves, and bitts of pokers, all suffer loss; even the air is deprived of its oxygen by fire and combustion. Thus, from the law being general, communicating and radiating the physical non-entity heat, is evidently false philosophy.

When bodies experience no loss of weight or derangement of texture by fire, they suffer loss of free electric matter only. Of this matter the cylinder of the electrifying machine contributes little or none when revolved before a fire; its electric atmosphere is forced from it, and towards the fire.

The loss suffered by water on the fire consists of one or more of the elements of the water, which is forced downwards, collects on the bottom of the vessel, as may be noticed in glass retorts and bright saucepans, in the form of small air-bubbles, which are eventually forced through the bottom into the fire. The whole of the portion of water thus de-electrized has been decomposed: it has lost to the fire some elementary matter—the complement of its elements is thrown over. The latter are not the whole of steam, their volume being many hundred times less than that of steam is proof.

The elementary matter forced out of the water into the fire is succeeded by an influx of the medium of space, the quantity and force of which expands the water, and throws out, at the same time, the elementary matter just mentioned, which, with an enormous accession of the medium of space, altogether form steam. The force, therefore, of steam is derived from the pressure of this medium. Steam becomes converted to water as it acquires elementary matter of the same kind as that of which the water it was formed had been deprived by fire. The return of this matter displaces the medium of space, and water is the result. Cold being but a sensation, there is no such physical agent concerned in the formation of water from steam: unalterable matter cannot be made hot or cold. He who shall first galvanize, or otherwise de-electrize water, as is done by means of fire, will be enabled to pay off the national debt!

Now, as the fire is constantly de-electrizing the water in the boiler, and as the area of the boiler is of a limited space, it would appear that much more of the medium of space would enter the boiler, were there space for its reception; which seems proved by the steam being forced against the safety-valve, so as to make it give way, or if not, to explode the boiler itself. From which it is conceivable that steam, when suddenly let off into the cylinder or chest, and instantaneously allowed to pass through a narrow tube to impinge on an object only three-fourths of an inch distant—that in its passage through the air from the discharging orifice it may acquire an additional portion of the medium of space, and if so, the increased impetus of the steam is nothing improbable, and without having recourse to the motion of velocity, which is an element of momentum, begetting power which includes matter and velocity. Velocity is another name for motion; motion is an effect, and implies that it has for cause something physical, and in a

state of force; which some thing, or body, is perfectly distinct from that which is put and kept in motion, or in a state of velocity. As the effect, motion or velocity, must become cause to increase itself, the irrationality of the idea is evident. Then, when we deduct the philosopher's heat, also,—what are all these but effects of physical impulse, force, motion and velocity? What remains for the acting cause among the inert masses of solids, fluids, and air, of which the world is composed, to originate motion, produce expansion and give force to steam, if we do not refer to the universal cause which keeps the planets in motion, and which, from its universality, indicates that it has universal services to perform?

The acquired force of steam after leaving the boiler, which constitutes the discovery of Mr. Pilbrow, was discovered also by Mr. Parkes, C. E., in the year 1841, and recorded in the *Mechanics' Magazine:* wherein it is stated by Mr. Parkes, himself, that "this *extra* force, or percussion stroke, has been given to the piston by a force which is perfectly distinct from the steam's elastic force." The steam, from being suddenly let into the cylinder, permits some additional portion of the medium of space entering with it, but which quickly subsides; and this extra quantity it is which constitutes the extra force of Mr. Parkes, as a similar acquirement does Mr. Pilbrow's extra force beyond the nozzle of the orifice of discharge. The principles and theory are the same in both instances; and the whole which has been stated as the philosophy of steam is perfectly consistent with the inert nature of matter.

While the anti-natural, the false philosophy of the present day continues to be maintained, no wonder, that from want of a natural basis of philosophising, the most cogent reasons, and most strictly inductive reasoning should be unproductive of unity of opinion as to the *modus operandi* by which results are brought about. Although results are always such as they should be, their illustrations are all fallacious, and but mere guess-work wherein cause, procedure and effect, are not consistent with the inertia of matter. The numerous causes so arbitrarily assumed in modern philosophy, stand self-proved to be of mere fanciful origin, by illustration so frequently requiring the assistance of analogy, which, in the end makes the auxiliar stand for the principal analogy. The most preposterous examples, such as the increase of sound by means of a trumpet, are brought forward to prove that motion increases motion, velocity increases velocity, and that the degree of impact is increased by velocity increasing itself; all of which amounts to the absurdity of effect becoming cause of its own increase; and the analogy wholly fails by sound being nothing material, and only a sense-excited mental effect, a sensation. A falling body being accelerated, is not an analogous but a parallel case with that of increased force of steam at a distance from the boiler, it being in reason evident that increase of effect can only arise from additional impulse, or where the impulse is always equable, from more of the impelling cause acting on that which is impelled.

On the whole, I am inclined to think that the acquired additional force of steam is not available for mechanical purposes generally, and that as long as steam is the best-known applicable power, the use of the modern steam-engine is in no danger of being circumvented. But I do think that English talent and English art will yet grapple with nature's own power in an unincumbered state.

T. H. Pasley.

Jersey, April 1843.

FORCE OF IMPACT OF JETS OF STEAM.—MR. CHEVERTON IN REPLY TO "PROBE."

Sir,—Allow me a few lines to put myself right with your correspondent "Probe," in explanation of my remark and admission, in the case of Mr. Pilbrow's experiments on the impulsive force of a jet of steam, "that the pressure of impact may be greater than that which remotely originates it." To this your correspondent objects, that it is equal to saying, "that an effect may be greater than its cause," but he will not continue in this opinion, when his attention is drawn to the qualifying word "remotely," which entirely removes anything paradoxical in the remark. Besides, I had previously more explicitly stated, that the impulsive pressure is not derived immediately from the boiler, "but is generated anew, and is the result of the *momentum* of the effluent current, or of the generating pressure and velocity combined."

If the pressure in the boiler, and that on

the impelled point be one and the same by immediate communication, as in the usual mode of employing steam, it is of course, impossible that the latter should exceed the former; for in such case the effect would indeed "be greater than its cause;" but the cause of impulsive pressure in the way of impact is *not* the boiler pressure (except remotely) but the impinging force of the issuing steam, and this cause is adequate to produce a pressure of impact; not only greater, but more than double that which is in the boiler, in consequence of the velocity with which it acts. This doubling or more of the pressure, of which Mr. Pilbrow and Scalpel think so highly, is however but a poor compensation for the increased consumption of steam, which proceeds at the rate of the same immense velocity which obtains for them this slight advantage, so that instead of the effect being greater than the cause, it is as much less as the velocity of the impelled point is less than that of the jet of steam; the pressure on such point at such velocity being assumed *to be equal* to that in the boiler. If indeed, the double pressure at this point, as obtained by Mr. Pilbrow when it is *immoveable*, could be retained undiminished at whatever velocity it might be impelled, which I fear is the delusion that has proved an *ignis fatuus* both to that gentleman and your correspondent Scalpel—why then "the grandest and most original discovery of the age," would be nothing less than the perpetual motion itself, for the effect would rise even at a duplicate rate superior to the cause; but I should hope they need not to be informed, that if the impelling and impelled velocities be equal (which by the bye would require an assisting force equal to the friction) the pressure would be nothing, and the whole of the power would be lost instead of being doubled.

Your correspondent "Probe" will therefore perceive that it is not the pressure of impact alone being greater than that which remotely originates it, which will give Mr. Pilbrow an effect greater than its cause, but that to afford this result the product of such pressure, multiplied into the velocity at which it is obtainable, must be greater than the product of the boiler pressure multiplied into the velocity of the effluent steam; for the character and operation of the power is now widely altered from that of simple pressure acting slowly, as in a piston engine. The velocity of the steam is now prodigious, and must be made an element in the estimation of the cause; and besides, it no longer acts with the velocity of the effect, but always at a rate necessarily superior to it; therefore in instituting a comparison between cause and effect, both factors of the power, velocity as well as pressure, must be taken into the account for each; and their respective products will show, that to whatever extent the pressure of impact is superior to that of the boiler, it is dearly purchased by the velocity of the effect being to a much more than a corresponding extent inferior to the velocity of the cause.

It seems scarcely necessary to say, that it is the whole pressure of the impact which is taken; and that the comparison is made between it and the boiler pressure on an area equal to the aperture from which the steam issues. It is not now to be expected that these pressures should be equal, any more than that the pressure of a weight should be the same when resting on a surface, as when allowed to fall upon it from a height.

A greater paradox than what "Probe" supposes to exist in the present case, and suggested by his remarks, is this—any pressure upon the shorter arm of a lever "is greater than that which (*not* remotely) originates it;" and yet, however much there is an appearance in this instance of "the effect being greater than its cause," it cannot be so in reality; but I shall leave the explanation as an amusing exercise to those who may regard the subject as something curious.

The experiments to which your correspondent X. Y. Z. alludes, must have been made with an impinging jet of water *less* than the surface on which it struck, and therefore, are not analogous nor applicable to the floats of paddle wheels. When the jet is equal to, or greater than the surface, the resistance does not vary so much with the form that is given to it.

I am, Sir, yours, &c.,

BENJAMIN CHEVERTON.

DISCOVERY OF A METHOD OF INSTANTANEOUSLY EXTINGUISHING FIRE. BY DR. CLANNY.

Sir,—I take leave to inform you, for publication in your very valuable Journal, that I have recently performed a series of experiments with muriate of ammonia, in solution, as a medium for extinguishing fire. I use it in the following manner:—to every gallon of water I add five ounces of the salt, and with this solution a large fire was instantly extinguished.

To you, Sir, it is unnecessary to point out or explain the value of this discovery.

I am, Sir, your obedient servant,

W. REID CLANNY, M.D.

Sunderland, May 9, 1843.

DR. CLANNY'S METHOD OF BURNING SMALL COAL.

Besides the important discovery announced in the preceding letter, of the use which may be made of muriate of ammonia in the extinction of fires, Dr. Clanny has made another singularly ingenious and successful application of it to the burning of small coal, (called in the northern coal districts *duff*,) which, for want of some cheap method of solidifying it, has been hitherto treated as mere refuse. We extract the following account of it from a communication by Dr. Clanny to the *Northern Times* of the 21st of April.

"It has for some weeks been known to several of my respected friends, that I have been enabled to make a very lively and agreeable fire of duff coal in my own house. It may be needful to mention that, several years ago, I performed a series of expensive experiments upon this subject, and accomplished that which was by many persons considered as a desideratum, namely, the solidifying of duff or culm; but when I calculated the expense, I found, (as our neighbours have it,) that "the game was not worth the candle," or, in other words, the expense was so considerable, that the profit would thereby be absorbed. Reflecting that the duff is formed of the purest part of the coal, taken from the best coal seams, it struck me that, if I could render common strong brown paper to a certain degree incombustible, I might, within a small ready-made dry bag of this description, include a portion of the duff coal, which, when placed upon a ready-made fire, would become caked, and in that process give out gradually a clear flame, and be kept up for any length of time. For this purpose I tried saturated solutions of a variety of salts; and having, with such solutions, sufficiently moistened brown paper, and having it afterwards suitably dried, I submitted the duff to trials in parcels by the agency of such paper. I need not detail the results, for the same reason that I considered it unnecessary to detail the processes by which the duff was solidified, more especially as such processes are of no value, compared to the successful plan which I ultimately adopted. I found that the common muriate of ammonia (hydrochlorate of ammonia of chemists) answers the purpose admirably, and which I employed in the following manner:—Dissolve one ounce of the above-named salt in twenty ounces of common water,* which will serve to moisten a quire of the largest strong brown paper, such as is manufactured by Messrs. Hutton, in our vicinity, which is excellent in quality, and very moderate in price. As soon as this paper is carefully dried in the sun, or before a fire, it may be cut into pieces suitable for forming parcels—say about the size of a pound of brown sugar—taking care that the duff be not moist; and, for convenience, I use packthread, which I render incombustible, to a considerable extent, by the agency of the above-mentioned solution. Half-a-dozen of such parcels will make a fire which may be burnt in a couple of hours, or, by husbanding it, the fire may be made to last for six or eight hours. The muriate of ammonia may, in retail be had at a penny an ounce—perhaps, if from the manufacturer, it would cost half that sum. Any coal-owner, who may desire it, may see specimens at my house, and also the very agreeable fire they make. The cinders from this fuel are, perhaps, the finest ever seen, as the caking process is perfect, and the coal of the finest quality. Muriate of ammonia is now greatly reduced in price, and I am informed it is manufactured in large quantities at the different gas-works. The fires from the duff coal, such as described above, give out no noxious gases, nor any effluvia.

"P.S.—A few weeks ago, I transmitted to two of my personal friends, (who are greatly distinguished in the walks of practical science,) abundant specimens of my duff coal; and I have much pleasure in stating that both these gentlemen, by letter, gave the process and the fuel their unqualified approbation, couched in highly complimentary language. These letters may be seen at my house."

* Dr. Clanny states, in a subsequent communication to the "Northern Times," that there is an error in these proportions. "One ounce of muriate of ammonia should be dissolved in *ten*, not *twenty*, ounces of water; and if the water be warm, the solution will be instantly accomplished."

FLIGHT OF BIRDS.

Sir,—The following particulars from the Journal of Tyerman and Bennet's Missionary Voyages and Travels, compiled by James Montgomery, (vol. i. 8vo. 1831,) seems particularly deserving of notice; at a time when men appear determined to take to themselves wings and fly to the uttermost parts of the earth.

Speaking of a species of sea-fowls, called by sailors Molly-mauks (a variety of the *Diomedea fuliginosa*,) they thus describe two that were taken, as they passed Cape Horn.

"This bird is about the bulk of a goose in body, but the expansion of the wings,

though these are remarkably arched, reaches seven feet. Their flight is very graceful, and performed with little apparent exertion; though long in the air, they are seldom seen to flap a pinion, whether they rise or descend, go with the wind, or sail against it. The plumage on the back and upper parts is dark blue, and white beneath. When they alight on the water to seize their prey, these large fowls buoy themselves over the surface, with their wings balancing above their bodies, either to preserve their steadiness, or to be ready to take flight. When placed upon deck they are unable to raise themselves from the level; and when upon the sea it is curious to watch them taking advantage of the tops of the waves to mount aloft. When the water is smooth, they seem to run upon it with their feet for a great distance, and then rise very gradually before they can obtain full play for their wings."—(page 34.)

As this passage will doubtless prove especially gratifying to those mechanical flyers whose wings are not yet quite fledged, so perhaps another, occurring at page 39 of the same work, may afford a hint anticipatory of what may probably be further accomplished hereafter. Many *Sheer-waters* were flying around the ships—

"These birds appear to be equally fitted to fly in both elements; for when they dive after their prey, they *move* in pursuit of it under water with a velocity and force hardly less than the speed and the power that carry them through the air."

Though I entertain no high expectations of existing attempts to effect aerial transit, still it should not be overlooked, that if we nothing attempt, we can nothing gain; and, besides, there is always something to be learnt, as well from the failure as from the success of experiments. As respects mechanical flying, it may be justly asserted that it is one of those things which is of very doubtful practicability, and which, if even attained, is of the most uncertain utility.

I am, Sir, yours, &c.

D.

FALLING BODIES.

Sir,—The reply given to the question of your Oldham correspondent is amply sufficient for all practical purposes. If, however, he wishes for mathematical accuracy, there is a force in operation beyond that named, which slightly influences the result.

The query is this. "Suppose a vessel moving at the rate of 100 miles an hour, with a perpendicular mast 100 yards high, and a 5 lb. iron ball were released from the top of that mast, would it alight on the deck, at the same distance from the centre of the bottom of the mast as it was released from at the top?"

If the mast were at that moment truly perpendicular, the *vis inertia* of the ball would undoubtedly operate in bringing it to the precise point named in the question, and there it would descend, if the earth were absolutely at rest; but, as the earth performs a complete revolution upon its axis every twenty-four hours, and generates in this motion a great degree of centrifugal force, increasing in direct proportion to the distance from the centre, the ball and the top of the mast being more removed from this centre than the bottom of the mast, will have a greater relative velocity from west to east, and consequently the ball will fall *a little* to the east of the point named. This fact was practically demonstrated by Galileo, who dropped a stone from the top of the leaning tower of Pisa, and found that it did not descend in a truly vertical line, but passed a little to the eastward. The same principle applies conversely. If a ball be projected in a vertical direction into the atmosphere, it will not, when it reaches its highest elevation, lie immediately below the zenith, but, ascending in a gentle curve, it will arrive at a point a little to the *west* of the meridian of the observer.

I am, Sir, yours respectfully,

ISHAM BAGGS.

April 20, 1843.

[Mathematically speaking, some allowance must, no doubt, be made for the centrifugal action of the earth; but in a height of 100 yards—that of the mast, in the case submitted from Oldham—it is so small as to be practically inappreciable. Besides, if the question is to be considered in that light, a farther correction must be made for the latitude of the vessel at the time of the observation; the surface velocity of the earth varying between London and the equator, to the extent of no less than 477 miles.—ED. M. M.]

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN OLIVER YORK, OF UPPER COLESHILL STREET, EATON SQUARE, *for improvements in the manufacture of axles for railway wheels.* Patent dated 1842; Specification enrolled April 8, 1843.

The iron which is to form the axle is first made of the shape of a semicircular plate,

as shown in the sectional view, fig. 1. Such collars and ruffs as may occur in the axle are formed upon the plate previous to welding (and not put on as in a former patent of Mr. York's referred to,) which welding may be accomplished by means of the machine afterwards described, or by any of the common methods of welding. Or the axle may be made of three or more pieces, which, after being brought to the proper form as shown in fig. 2, are to be tied together and welded as in the former case.

Fig. 1.

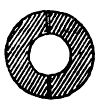
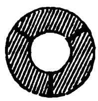


Fig. 2.



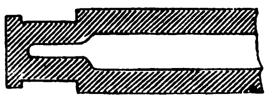


Fig. 3.

The closed ends are formed by hammering up part of the axle as shown in figure 3. Another method proposed for making the journals, is to insert into the hollow of the axle another piece, which, when the whole are welded together, forms a sufficiency of material, out of which the journals may be wrought.

It has been found that in general axles break immediately at the nave of the wheel; now to prevent any such accident taking place, either with a solid or hollow axle, Mr. York proposes the forms represented in figs. 4 and 5; *a a*, is a ring composed of two

Fig. 4.

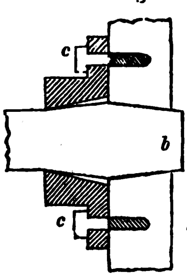
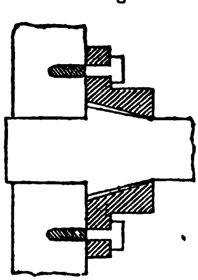


Fig. 5.



pieces, which embrace, without closely adhering to the shoulder *b* on the axle, and form a bearing which is no more liable to fracture at one part than at another. The ring is attached to the wheel by the screw bolts *c c*, so that the axle and wheel will be held together, although a fracture should take place at the nave. Other methods of forming bearings upon axles are shown in figs. 6 and 7. The pieces upon which the

Fig. 6.

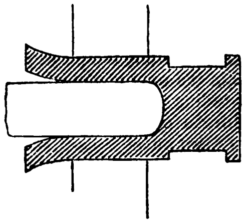
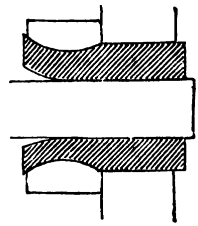


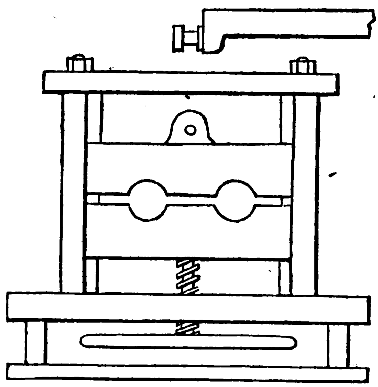
Fig. 7.



journals are formed, are fixed to the wheel with keys, and the axle is also fixed to them by the same means.

The machine by which the welding is to be performed is represented in fig. 8.

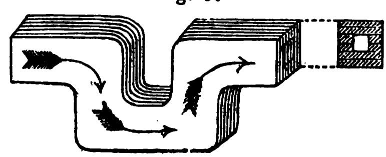
Fig. 8.



It consists of two semicircular dies which which move in guides which form the sides of the machine. On the top there is a revolving shaft, with a crank, from the end of which a connecting-rod proceeds, which gives a vertical motion to the upper die. During the intervals of its ascent and descent, the axle which has been previously brought to a welding heat is moved about, and the union completely formed. The under die is tempered by screws worked from below with a wheel so as to suit the exact size of axle or journal required.

Fig. 9 is a perspective view of a method of forming cranks for locomotive wheel axles. The various pieces are forged of the

Fig. 9.



crank shape, so that the reed, or fibre of the metal may run in the course marked by the arrow.

Mr. York also proposes to have pieces of metal either iron or steel, upon which the journal is formed to be connected to the ends of the axle by a cotter, the position of which is be within the nave of the wheel to prevent fracture taking place; which pieces are made moveable, in order that they may be replaced when worn out.

Lastly, Mr. York proposes the formation of hollow shafts of cast steel, by first casting a piece four or five feet, and drawing it out by the machine above mentioned, to the proper length, and forming the requisite journals thereon.

Mr. York's claims are as follows:—1. The formation of hollow axles of two pieces, as shown in fig. 1.

2. The formation of axles out of three or more pieces, where the internal diameter is not less than half the external.

3. The formation of journals on hollow axles by means of a piece inserted into the hollow of the axle as before explained.

4. The connecting solid or hollow axles, as in figs. 4 and 5.

5. The forming bearings in the manner represented in figs. 6 and 7.

6. The welding by means of dies as shown in fig. 8.

7. The construction of locomotive cranks as shown in fig. 9.

8. The connecting of iron or steel bearings which admit of being replaced when worn, and the application of cast steel to the formation of hollow axles.

John George Shipley, of Bruton-street, Berkeley-square, Saddler, *for certain improvements in saddles.* Patent dated Oct. 6, 1842; Specification enrolled April 6, 1843.

The first of these improvements consists in having the "pannel" quite detached from the "tree:" in saddles this has not heretofore been the case, which is the cause of frequent annoyance; as for instance, when the pannel gets wet, the saddle can not be put before a fire to dry, because the other materials of which it is composed are liable to be injured by the heat. Mr. Shipley attaches the "pannel" to the "tree" with springs, which when pushed into their place are not easily withdrawn, but yield to pressure, applied for the express purpose, when the pannel is required to be taken out to dry, repair, &c. To the under side of the "tree" there are thongs attached, by which moveable pieces of thick felt lining may be attached thereto, and one piece readily changed for another, so that the same saddle which fits one animal may be made in a few minutes to answer for a larger. These thongs also serve to attach metal plates by, instead of the lining, on occasions when it is required to carry a definite weight, as in racing or steeple chases. Mr. S. also forms the "tree" of bars of steel and whalebone, or either separately. The "straining" is formed of whalebone and canvas, being attached to the saddle in the usual manner.

The patentee claims 1. The connecting the "pannel" to the "tree" with springs or hooks.

2. The using of moveable felt linings.

3. The attaching of metallic plates for additional weight.

4. The formation of the "tree" of bars of steel and whalebone, separate or combined.

Peter Kagenbusch, of Lyth, in the County of York, Dyer, *for certain improvements in the treatment of the Alum Rock or Schist, and in the manufacture and application of the products derived therefrom.* Patent dated 13th of October, 1842; Specification enrolled 13th of April, 1843.

Mr. Kagenbusch makes four distinct claims:—The first is, for making "Water Heaps" or heaps of the alum shale broken small, and sprinkled with water as the heap is laid. The heaps are to be plastered over in the usual way, and are to stand from three to eight months.

The 2nd, for burning these "Water heaps," at the expiration of this time in kilns or close heaps *with turf;* wood or coal *may* be used.

The 3rd, for steeping the alum shale, when burned, in the pits along with kelp, or for steeping kelp in raw alum liquor, in the proportion of three quarters of a ton of kelp to as much alum shale, or alum liquor, as will yield one ton of alum.

And the 4th, for burning the exhausted shale on iron plates, alone, to make puzzolana, or with lime, in kilns,—made into bricks or lumps for hydraulic cement.

In order fully to appreciate these improvements, it is necessary to inform our readers, that the alum rock on the Yorkshire coast yields, besides alum, another salt in equal quantity, which is a mixed sulphate of magnesia and iron. This salt formerly was suffered to run into the sea, but of late years about one half of it has been preserved for sale in all the works—the Boulby works alone, recovering the whole of the sulphate of magnesia entirely free from iron. About one ton of pure sulphate of magnesia may be obtained for every ton of alum by proper management.

It is well known that some of the alum rocks on the Continent, yield alum by spontaneous decomposition, which is the object

intended to be effected by the first claim in the present patent; and it is equally well-known that the Yorkshire alum schist will not, and the fact is noticed in a paper published in the 12th vol. of the Phil. Trans. for 1676, p. 1052, by D. Colwell, Esq., in which he says, "the rock exposed to the air and moisture, crumbles and produces green vitriol, but being burned is fit for alum." And we have the authority of the late Mr. Sowerby, of Whitby, that such a mode of heap making was tried at the Mulgrave works without success.

The second claim is for the employment of turf as fuel.

The third claim is for the exclusive privilege of "advancing backwards" to the rudest mode of employing kelp, described in the paper above alluded to as "practised commonly in the alum works in Yorkshire, from Scarboro' to the River Tees," but long since laid aside.

Muriate, or sulphate of potash, or sulphate of ammonia, are now used by alum makers as the source of the alkali necessary to form alum—the potash salts being obtained from kelp.

One ton of absolutely pure muriate of potash (K Cl) will yield potash equivalent to 6¼ tons of alum; but it is found, in practice, that not more than from 4 to 5 tons of alum are produced from one ton of the muriate of potash of commerce. Now, one ton of kelp yields from 5 to 6 cwt. of such muriate. The Patentee then, we see employs about the *practical* equivalent of kelp to produce a ton of alum, but he would appear to be altogether ignorant of the fact that the carbonate of soda, and sulphuret of sodium included in the kelp will as far as they go, decompose his alum, and that the sulphate of soda will remain in his "mother liquors" to contaminate the sulphate of magnesia by which means he will commit, we hope, an *involuntary* fraud upon the purchasers of this latter salt.

There is another mischief to the alum maker, in this rude mode of employing kelp, which may not be generally anticipated. An eminent chemist has informed us, that he has proved the presence of sulpho-cyanogen compounds in kelp, by their producing the characteristic blood red colour with the iron in the alum liquor. This has already been productive of serious injury to the alum in the Mulgrave Works from the employment of muriate of potash drenched with kelp "mother liquors."

The fourth improvement, "for burning the exhausted shale on iron plates alone" is not likely to be interfered with by cement makers, whose object is to make money at the same time.

It has been for a long time the opinion of the best chemical authorities that the "artificial alum makers" on the Tyne, will in time supersede the "natural alum makers," as they are incorrectly termed, seeing that the process followed by each is equally artificial: and these *improvements* do not tend, in the slightest degree, to shake that opinion.

JOHN BIRD, OF MANCHESTER, MACHINIST, *for certain improvements in machinery for raising or forcing of water and other fluids, which said improvements are also applicable as an engine to be worked by steam, for propelling vessels, and other purposes.* Patent dated July 7, 1842; Specification enrolled January 7, 1843.

The *first* and best of these improvements is one which we are saved the trouble of describing, by a former article in our Journal, in which they happen to have been already described most fully and circumstantially, that is, two or three years before they were invented by Mr. Bird. In our 29th vol., p. 321, we gave an account of a very ingenious rotary steam-engine, patented by Mr. Edm. B. Rowley, of Manchester, which is precisely the same as that now repatented by Mr. Bird. The only difference is a difference, not in the thing, but in the name given to it. Mr. Rowley called his invention a rotary steam-engine, which might also be applicable as an apparatus for raising or forcing water; while Mr. Bird calls his an apparatus for raising or forcing water, which may be also applicable as a steam-engine. Indulgent as our patent law is to new arrangements of old things, we hardly think it will extend its protection to such a mere titular transformation as this. It falls greatly short even of the often-quoted, and quoted only to be derided, case of the attempt to infringe Mr. Watt's patent for the steam-engine, by turning the engine upside down! There the thing was reversed, here it is the title only. The coincidence between the two patents is the more remarkable, that both the patentees are residents of the same town. What if they should happen to be next door neighbours!

Mr. Bird's *second* improvement consists in constructing paddle-wheels on the same principle as the pumping apparatus. The paddle-wheel is made to draw in its horns (boards) by a projecting cam piece, as soon as they pass the point of deepest immersion, and every moving part has its regulating spring, in order that this constant moving out and in may be effected with all the precision and regularity of clock-work, under the greatest strains, and throughout the longest voyages. This certainly *is Mr. Bird's own*, (though, by the way, not co-

vered by his title;) Mr. Rowley seems to have had no idea that steam paddling was so easy an affair.

A *third* "improvement" consists of a pump, of the following construction. A revolving shaft passes across the top of the cylinder, immediately under the cover, and is connected with the piston by a series of cross levers, on the lazy-tongs principle, so that as the shaft is turned in one direction, the tongs are collapsed, and draw up the piston along with them, while, on being turned the reverse way, the tongs expand and thrust down the piston. This lazy-tongs piston-shaft (!!!) is another of Mr. Bird's *own.*

The specification describes, *fourthly*, a mode of converting a rectilineal into a circular motion, by means of a vertical rod screwed at top and bottom in contrary directions, which serves the purpose both of a vertical piston-rod and a horizontal revolving shaft.

And, *fifthly*, a mode of packing pistons with cork, instead of any of those materials commonly employed—the cork being inserted between two plates, (which constitute the piston,) and pressed outwards by screws.

APPLICATION OF THE ARGAND FURNACE TO STEAM-VESSELS.

We have been favoured with a tabular summary of the answers returned by the commanders and engineers of seventeen different steam-vessels, to which Mr. C. W. Williams's Argand Furnace has been applied, respecting the advantages realised by it. The vessels are the Hibernia, Ballinasloe, Nottingham, Athlone, Royal Adelaide, Royal William, Prince, Princess, Leeds, Birmingham, Mars, Oriental, Hindostan, Shannon, Dædalus, Queen Victoria, and Branda. The most remarkable answers are the following. *Officers of the Princess.*—"Without the air-pipes, we made 16 voyages=371 hours, and consumed 571 tons of coal; with the air-pipes, we made 16 voyages=379 hours, and consumed 522 tons—saving 49 tons. A great quantity of dense black smoke formerly; now scarcely any smoke after the fires are well lighted." *Officers of the Oriental.*—"We think we are saving from 3 to 4 cwt. per hour. For many voyages, our consumption averaged 26 cwt. per hour: it was 30 cwt. previously. No smoke, only when firing, or upon raking, and then only a slight volume for a few seconds." *Officers of the Hindostan.*—"The air-boxes are a great saving, both in fuel and supporting the bridges: smoke is now seldom or never seen." The following remarks are subjoined to the summary, and appear to us to be fully borne out by it.

"By the above returns it will be seen that the advantages are greater in some vessels than in others. This difference is chiefly attributable to the construction of their boilers. In marine, as well as land engine boilers, the arrangement of the flues frequently renders them incapable of improvement; such arrangement not only injuring the draught, but tending to obstruct, rather than aid, the natural and chemical process of the combustion of the gaseous matter of the coal. In some of the boilers in the above table, there appears to be a considerable saving of fuel where there had been a sufficiency of steam. In others, the advantage of the apparatus is shown by obtaining a better supply of steam from the same quantity of fuel. In all, the great evil of smoke is avoided. Where furnaces are properly attended to, by having the bars kept *thickly* and *uniformly* covered with fuel, smoke will be prevented, and more heat generated. Any deviation from this, by having the fire bars too long—by improperly feeding the furnaces or allowing the fuel to burn in holes or irregularly—or by heaping the fresh coals in front, and allowing the back part of the bars to be uncovered or without the full supply of fuel, will be attended, either with the generation of *visible* smoke, or the escape of the gases unburnt, though *invisible*, with a loss of heat, and consequently a diminution of steam. It is here to be noted, that the absence of *visible black* smoke is no test of the combustion of the gases. What is called the "combustion of smoke" is not unfrequently the effect of the mismanagement of the fuel, by which its inflammable gases pass away in an *invisible* form. Smoke is the result of the imperfect process of combustion of the gases, and as the process cannot be twice performed in the same furnace, the "combustion of smoke" is hence a chemical absurdity. Dr. Ure, writing to Mr. Williams, says, "I quite agree with you in considering the *prevention of smoke* to be the true mode of curing the nuisance; for when the carbonaceous particles become deposited, it is impossible effectually to burn them, so as to destroy the smoke which they occasion, or rather constitute.' Professor Brande says, 'As to the quibble about *burning smoke*, it is, in other words, burning what is to be presumed has already been burned, and therefore cannot be burned twice over,' &c. 'I can see nothing that in the least invalidates your views respecting the *prevention of smoke*, by the combustion of that which would become smoke, *if you would let it.*'"

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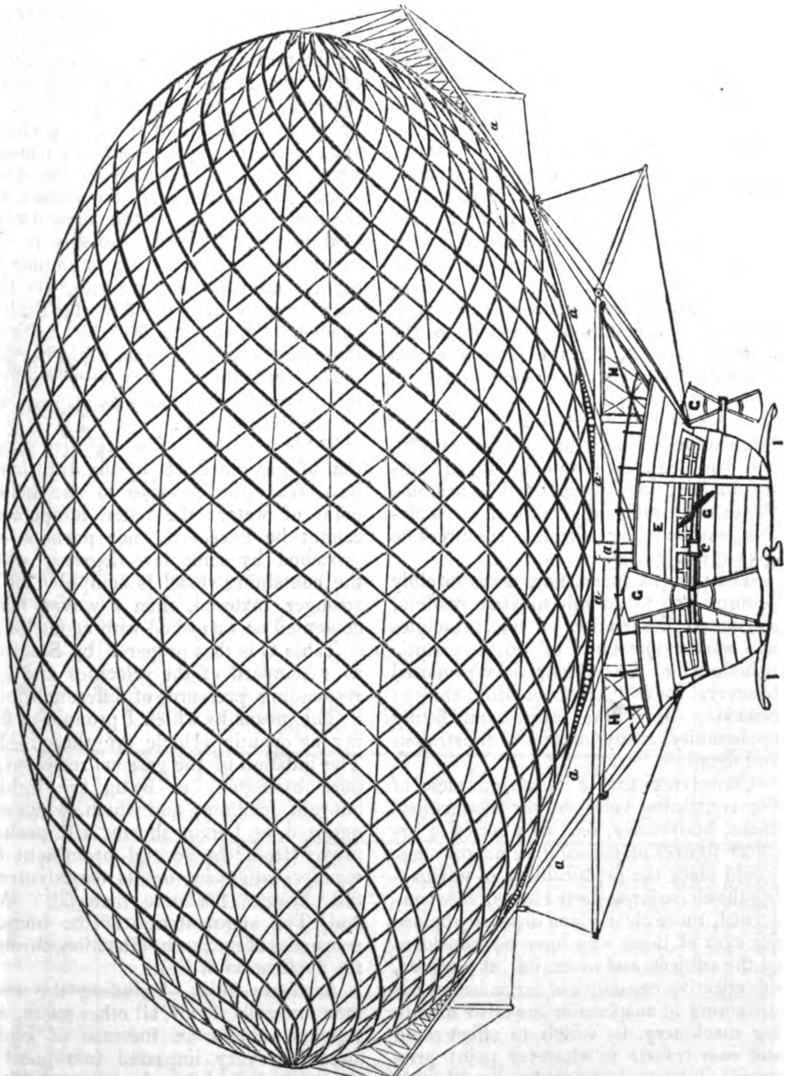
Fig. 1.



PARTRIDGE'S PNEUMODROMON.

DESCRIPTION OF THE PNEUMODROMON, OR AERO-LOCOMOTIVE VEHICLE DESIGNED BY MR. J. S. PARTRIDGE—COMMUNICATED BY THE INVENTOR.

Sir,—In the pages of the *Mechanics' Magazine*, from its commencement to the present time, embracing a period of full 20 years, there have been recorded many valuable plans and suggestions for the accomplishment of aerial navigation—an art, or science, still in its infancy, not because of its incapability of vigorous and perfect developement through any inherent or insurmountable natural defect, but on the contrary, owing solely to the want of a nourishing and fostering public patronage. I cordially agree with Sir George Cayley, that it redounds to the *very* "disgrace of the nation," that, long before this time, it has made no proper provision to promote and enable the necessary scientific experiments and investigations to be conducted on a scale of magnitude, commensurate with the importance of the object. Greatly is aerostation indebted to the learned baronet, for the long attention and valuable assistance which it has received at his hands. I believe he has, from his own private resources expended large sums of money in furtherance of it, and has also used strenuous, though unfortunately, unavailing efforts to promote the establishment of an effective association, commanding adequate resources to give it a fair trial.

The present interesting crisis forcibly prompts me to submit to your readers, a general description of the principles and *modus operandi* of an aeronautic vehicle which I have long since proposed to several individuals of scientific ability; reserving, for some future and fitting opportunity, many matters of illustration and detail.

Conceiving that a tabulated view of the containing volumes, surfaces, resistances, buoyancies, &c., of a series of similar figures of consecutive magnitudes, would place the practicability of navigating the air, so far as these elements are concerned, more clearly and distinctly before the eyes of those who have not considered the subject, and so exhibit, at a glance, the effective capacities of large bodies for sustaining in suspension powerful actuating machinery, by which to effect rapid and easy transit to whatever point proposed; I have, in accordance with this view, drawn up the accompanying Table A. The given bodies in this Table are of the form of a *compressed prolate spheroid*, whose respective diameters bear proportion to the integers 7, 4, and 2; extending in number from the initial, to the fortieth integral magnitude in regular series: the diameters are given in feet. I have chosen this figure because of its allowing of convenient suspension by the means to be presently explained; of its preserving its original form better than the regular spheroid; and of its being most suitable to the easy performance of the requisite locomotive manœuvres. The first few sizes in the Table would serve, if required, for models, and the latter numbers for the efficient practical bodies. Though probably it may never be found necessary to employ the highest numbers of the series, yet they may serve by their place in the Table to show how, if it were desirable, bodies of these enormous dimensions could be really made available to carry very powerful motive machinery, many passengers, and even a light freight.

Table B exhibits the uniform dilatation of gaseous fluids by the diffusion of heat, from the freezing to the boiling point of water; the latter temperature cannot be exceeded, nor perhaps approached by some few degrees, whilst the containing vessel is composed of no stronger material, than a woven fabric cemented or varnished with caoutchouc.

Table C is that prepared by Smeaton, as a standard of the velocities and corresponding pressures of different winds.

The means by which I propose to float my aeronautic vehicle are these:—1st, The inflation of the gaseous recipient by pure hydrogen, as being the lightest buoyant medium, and which, when economized, as herein shown, will perhaps prove (from the several prominent advantages attendant on its employment,) the cheapest floatative material. And 2nd, The augmentation of the buoyant properties of the gas by dilatation, through the application of heat.

Aeriform fluids—including the common atmospheric air, all other gases, and vapours—obtain an increase of elastic force for every imparted increment of temperature, and therefore expand, if expansion be accommodated, in the vessel containing them. The ratio of ex-

pansion when the temperature ranges from the freezing to the ebullition point of water at the level of the sea, (being 32° to 212° of Fahrenheit's, from 0° to 80° of Reaumur's, and from 0° to 100° of the centigrade thermometers,) is 375 parts out of a thousand of the bulk at the freezing point. The dilatation is uniform, except perhaps slightly, under very high and very low temperatures; it is quite so

TABLE A.

Integral Magnitudes.	Dimensions of Breadth, Height, & Length. in feet.			Surface: square feet.	Surface: square yards.	Area of greatest perpendicular cross section in feet.	Volumes in cubic feet.	Volumes in cubic yards.	Weight Envelope.			(1 Cubic foot = 525 grs. or $1\frac{1}{5}$ oz.) Weight of displaced atmospheric air.			(1 Cubic foot = 40 grs. or $\frac{1}{11}$ oz. Weight of volume in pure Hydrogen			Floatage, or supporting weight in pure hydrogen.			Integral Magnitudes.
									Tons.	cwt.	lbs.	Tons.	cwt.	lbs.	Tons.	cwt.	lbs.	Tons.	cwt.	lbs.	
1	2	4	7	52·36	5·817	6·2832	29·3216	1·086			5.817			2·19912	(2·6656 oz.)		·1666			2·03252	1
2	4	8	14	209·44	23·271	25·1328	234·5728	8·688			23·271			17·59296			1·3328			16·26061	2
3	6	12	21	471·24	52·360	56·5488	791·6832	29·322			52·360			59·37624			4·4982			54·87804	3
4	8	16	28	837·76	93·084	100·5312	1876·5824	69·503			93·084		1	28·74368			10·6624		1	18·08128	4
5	10	20	35	1309·00	145·444	157·0800	3665·2000	135·748		1	33·444		2	50·89000			20·8250		2	30·06500	5
6	12	24	42	1884·96	209·440	226·1952	6333·4656	234·573		1	97·440		4	27·00992			35·9856		3	103·02432	6
7	14	28	49	2565·64	285·071	307·8768	10057·3088	272·493		2	61·071		6	82·29816			57·1438		6	25·15436	7
8	16	32	56	3351·04	372·337	402·1248	15012·6592	556·024		3	36·337		10	5·94944			85·2992		9	32·65024	8
9	18	36	63	4241·16	471·240	508·9392	21375·4464	791·683		4	23·240		14	35·15848		1	9·4514		13	25·70708	9
10	20	40	70	5236·00	581·777	628·3200	29321·6000	1085·985		5	21·777		19	71·12000		1	54·6000		18	16·52000	10
11	22	44	77	6335·56	703·951	760·2672	39027·0496	1445·446		6	31·951	1	6	15·02872		1	109·7446	1	4	17·28412	11
12	24	48	84	7539·84	837·760	904·7808	50667·7248	1876·582		7	53·760	1	13	104·07936		2	63·8848	1	11	40·19456	12
13	26	52	91	8848·84	983·204	1061·8608	64419·5552	2385·909		8	87·204	2	3	15·46664		3	30·0202	1	19	97·44644	13
14	28	56	98	10262·56	1140·284	1231·5072	80458·4704	2979·943		10	20·284	2	13	98·38528		4	9·1504	2	9	89·23488	14
15	30	60	105	11781·00	1309·000	1413·7200	98960·4000	3665·200		11	77·000	3	6	30·03000		5	2·2750	3	1	27·75500	15
16	32	64	112	13404·16	1489·351	1608·4992	120101·2736	4448·195		13	33·351	4	0	47·59552		6	10·3936	3	14	37·21092	16
17	34	68	119	15132·04	1681·337	1815·8448	144057·0208	5335·445		15	1·337	4	16	52·27656		7	34·5058	4	9	17·77076	17
18	36	72	126	16964·64	1884·960	2035·7568	171003·5712	6333·466		16	92·960	5	14	57·26784		8	75·6112	5	5	93·65664	18
19	38	76	133	18901·96	2100·217	2268·2352	201116·8544	7448·772		18	84·217	6	14	73·76408		10	22·7094	6	4	53·05468	19
20	40	80	140	20944·00	2327·111	2513·2800	234572·8000	8687·881	1	0	87·111	7	17	8·96000		11	100·8000	7	5	20·16000	20
21	42	84	147	23090·76	2565·640	2770·8912	271547·3376	10057·309	1	2	96·640	9	1	94·05032		13	86·8826	8	8	7·16772	21
22	44	88	154	25342·24	2815·804	3041·0688	312216·3968	11563·570	1	5	15·804	10	9	8·22976		15	93·9568	9	13	26·27296	22
23	46	92	161	27698·44	3077·604	3323·8128	356755·9072	13213·182	1	7	53,604	11	18	100·69304		18	11·0222	11	0	89·67084	23
24	48	96	168	30159·36	3351·040	3619·1232	405341·7984	15012·659	1	9	103·040	13	11	48·63488	1	0	63·0784	12	10	97·55648	24
25	50	100	175	32725·00	3636·111	3927·0000	458150·0000	16968·518	1	12	52·111	15	6	89·25000	1	3	27·1250	14	3	62·12500	25
26	52	104	182	35395·36	3932·817	4247·4432	515356·4416	19087·276	1	15	12·817	17	5	11·73312	1	6	16·1616	15	18	107·57152	26
27	54	108	189	38170·44	4241·160	4580·4528	577137·0528	21375·446	1	17	97·160	19	6	53·27896	1	9	31·1878	17	17	22·09116	27
28	56	112	196	41050·24	4561·137	4926·0288	643667·7632	23839·547	2	0	81·137	21	11	3·08224	1	12	73·2032	19	18	41·87904	28
29	58	116	203	44034·76	4892·751	5284·1712	715124·5024	26486·093	2	3	76·751	23	18	98·33768	1	16	31·2074	22	2	67·13028	29
30	60	120	210	47124·00	5236·000	5654·8800	791683·2000	29321·600	2	6	84·000	26	10	16·24000	2	0	18·2000	24	9	110·04000	30
31	62	124	217	50317·96	5590·884	6038·1552	873519·7856	32352·585	2	9	102·884	29	4	105·98392	2	4	35·1806	27	0	70·80332	31
32	64	128	224	53616 64	5957·404	6433·9968	960810·1888	35585·562	2	13	21·404	32	3	44·76416	2	8	83·1488	29	14	73·61536	32
33	66	132	231	57020·04	6335·560	6842·4048	1053730·3392	39027·050	2	16	63·560	35	5	69·77544	2	13	51·1042	32	12	18·67124	33
34	68	136	238	60528·16	6725·351	7263·3792	1152456·1664	42683·562	3	0	5·351	38	11	82·21248	2	18	52 0464	35	13	30·16608	34
35	70	140	245	64141·00	7126·777	7696·9200	1257163·6000	46561·615	3	3	70·777	42	1	95·27000	3	3	86·9750	38	18	8·29500	35
36	72	144	252	67858·56	7539·840	8143·0272	1368028·5696	50667·725	3	7	35·840	45	16	10·14272	3	9	44·8896	42	6	77·25312	36
37	74	148	259	71680·84	7964·537	8601·7008	1485227·0048	55008·408	3	11	12·537	49	14	64·02536	3	15	38·7898	45	19	25·23556	37
38	76	152	266	75607·84	8400·871	9072·9408	1608934·8352	59590·179	3	15	0·871	53	17	46·11264	4	1	69·6752	49	15	88·43744	38
39	78	156	273	79639·56	8848·840	9556·7472	1739327·9904	64419·555	3	19	0·840	58	4	81·59928	4	8	26·5454	53	16	55·05388	39
40	80	160	280	83776·00	9308·444	10053·1200	1876582·4000	69503·052	4	3	12·444	62	16	71·68000	4	15	22·4000	58	1	49·28000	40

Table B.

Table of Aeriform or Gaseous Expansion indicated by Fahrenheit's Thermometer, from the freezing to the boiling points.

Deg.	Volumes.	Deg.	Volumes.
32	1·000,000	82	1·104,166 = $\frac{53}{48}$ or $1\frac{5}{48}$
33	1·002,083 = $\frac{481}{480}$ or $1\frac{1}{480}$	92	1·125,000 = $\frac{9}{8}$ — $1\frac{1}{8}$
34	1·004,166 = $\frac{241}{240}$ — $1\frac{1}{240}$	102	1·145,833 = $\frac{55}{48}$ — $1\frac{7}{48}$
35	1·006,250 = $\frac{161}{160}$ — $1\frac{1}{160}$	112	1·166,666 = $\frac{7}{6}$ — $1\frac{1}{6}$
36	1·008,333 = $\frac{121}{120}$ — $1\frac{1}{120}$	122	1·187,500 = $\frac{19}{16}$ — $1\frac{3}{16}$
37	1·010,416 = $\frac{97}{96}$ — $1\frac{1}{96}$	132	1·208,333 = $\frac{29}{24}$ — $1\frac{5}{24}$
38	1·012,500 = $\frac{81}{80}$ — $1\frac{1}{80}$	142	1·229,166 = $\frac{59}{48}$ — $1\frac{11}{48}$
39	1·014,583 = $\frac{487}{480}$ — $1\frac{7}{480}$	152	1·250,000 = $\frac{5}{4}$ — $1\frac{1}{4}$
40	1·016,666 = $\frac{61}{60}$ — $1\frac{1}{60}$	162	1·270,833 = $\frac{61}{48}$ — $1\frac{13}{48}$
41	1·018,750 = $\frac{489}{480}$ — $1\frac{9}{480}$	172	1·291,666 = $\frac{31}{24}$ — $1\frac{7}{24}$
42	1·020,833 = $\frac{49}{48}$ — $1\frac{1}{48}$	182	1·312,500 = $\frac{21}{16}$ — $1\frac{5}{16}$
52	1·041,666 = $\frac{25}{24}$ — $1\frac{1}{24}$	192	1·333,333 = $\frac{4}{3}$ — $1\frac{1}{3}$
62	1·062,500 = $\frac{17}{16}$ — $1\frac{1}{16}$	202	1·354,166 = $\frac{65}{48}$ — $1\frac{17}{48}$
72	1·083,333 = $\frac{13}{12}$ — $1\frac{1}{12}$	212	1·375,000 = $\frac{11}{8}$ — $1\frac{3}{8}$

Table C.

Smeaton's Table of the Pressure of Winds of different velocities impinging upon a square foot of surface exposed vertically, or directly opposite to the current. *Philosophical Transactions* for 1759; afterwards confirmed by the experiments of Dr. Hutton. The first column is an approximate representation of the second.

Velocity of wind.		Force on one square foot in lbs. avoirdupois.	Character of the Wind.	Velocity of wind.		Force on one square foot in lbs. avoirdupois.	Character of the Wind.
Miles per hour.	Feet per second.			Miles per hour.	Feet per second.		
1	1·47	·005	Hardly perceptible.	30	44·01	4·429	High winds.
2	2·93	·020	Just perceptible.	35	51·34	6·027	
3	4·40	·044		40	58·68	7·873	Very high.
4	5·87	·079	Gentle, pleasant wind.	45	66·01	9·963	
5	7·33	·123		50	73·35	12·300	Great storm.
10	14·67	·492	Pleasant brisk gale.	60	88·02	17·715	
15	22·00	1·107		80	117·36	31·490	Hurricane.
20	29·34	1·968	Very brisk.	100	146·70	49·200	Destructive hurricane.
25	36·67	3·075					

within the range to which any application can be required for the present purpose. The increase of volume corresponding to one degree of each of the three thermometers, is respectively $\frac{1}{480}$, $\frac{3}{840}$, $\frac{3}{800}$. *At the same temperature,* the elastic forces of two portions of air or gas, are in direct proportion to the densities, or in inverse proportion to the spaces occupied by these portions. If we take a bladder partially filled with gas or air under the ordinary atmospheric temperature (say three-fourths filled) and place it under the receiver of an air pump; if exhaustion of the receiver be then effected, the membrane is found to expand (as its surrounding atmosphere is attenuated,) from the elastic force of the contained gas being in proportion to the density of the circumambient air; and when one-fourth of the original atmospheric pressure external to the bladder has been removed, it becomes fully distended. So with respect to balloons, the gas has a tendency to expand in the higher regions of the atmosphere, from the decreased density of the external air, but is restrained by the confining envelope,—assuming the balloon to have been at the tension point at starting from the earth's surface; therefore, if a portion of gas, equivalent to the sustaining tension of the body, or a little more, were not allowed to escape, the envelope would be

exposed to the danger of being at last rent from extreme stretching, when the difference of the internal over the external pressure became sufficiently great. If the balloon, on the contrary, is at the commencement in a partially collapsed state, but possesses a buoyant power adequate to float at a high altitude, then on its progressive ascension, it becomes more and more distended in proportion to its increasing elevation. Such being the disturbing effects of dilatation by heat, and of expansion arising from diminished pressure due to the attainment of altitude—it follows, that as the common balloon has no self-sustaining provision for counteracting the consequences of these vicissitudes, except at a loss of first power, the aeronaut is forced to the constantly recurring necessity of discharging ballast or gas as often as ascension or descent is required. It will be readily accorded, therefore, that if the gas-containing vessel were of fitted capacity, and provided with an agency for raising the temperature to any required amount—say from the freezing point to 192 deg. of Fahrenheit (or 160° beyond congelation), and if at the lowest point, when completely equipped for a voyage, it were required to possess a buoyancy just sufficient to float its own weight and cargo, but not to rise above the surface of the earth into "mid air,"—then the vessel, under the stated conditions, would require to be only three-fourths filled with gas.* But this quantity of the gaseous fluid, by additional impartation of heat, could support a much greater burden; that is, by raising the temperature from the lower to the higher point named, *the original gaseous volume is expanded one fourth part, and a super-proportion of buoyancy created, equal to this extra atmospheric displacement*, by which important acquisition of means for thus largely altering specific gravity, if recipients of extensive capacity were employed, the overplus elevating power would be of proportional amount—considerable—sufficient to allow of the use of the steam-engine in the propulsion of the vehicle; inasmuch as the loss of weight to the balloon, from the combustion of fuel, could be compensated by a simultaneous reduction of temperature.

According, however, to our first premises, when under the influence of refrigeration the envelope would be partially collapsed, which state is unfavourable to the sustaining of* pressure or resistance arising either from strong opposing winds or high velocities in a calm medium; for it is necessary to the preservation of the vehicle that it should retain its form, or a firm tension of surface, in the face of the highest winds, or the greatest velocities to which it may be subjected.

The object of tension of surface can, however, be very readily and simply obtained by the introduction of an atmospheric air cell, contained within the body of the gas recipient, of capacity sufficient to compensate the required amount of dilatation.

The propulsion of the pneumatic vessel, in any required direction, I propose to effect through the power of a steam-engine acting on two different kinds of propellers. The first are vertical, and work on the spiral principle, their action tending to impel the vessel in a horizontal course; the others are sets of horizontal paddles or fanners, whose air supply is received in the plane of the axis, vertically, and thrown out from the apparatus, by the centrifugal action of the blades, into a plane parallel to the horizon. By the intervention of a suitable casing to the fans, having always but one side open and one closed, (though this lateral impinging surface is always capable of instant reversal,) and possessing also a partial circumferential impingement, the air, which without this casing would have been imparted towards the centre in two opposite vertical streams, is admitted only on one, namely, the open side, impinges on the opposite, and is delivered by the centrifugal action of the blades obliquely against the vertical impingement, as far as it extends; whereby reaction of the current upon the atmosphere takes place horizontally, and there is constantly produced, in relation to the blowing-fan, an upward or downward pressure, and

* A simple rule may be applied for determining what the known bulk of a gas at a given temperature will be at any other temperature, founded on the law of uniform expansion of aeriform fluids For example: suppose it is desired to know what the bulk of three cubic feet of hydrogen at 32° will be at 60°? Subtract 32 from 480, the remainder is 448; to which add the degrees above zero indicating the temperature of the gas—these are 32° and 60°, making 480 and 508. Then say,

480 ; 508 ;; 3 ; 3·175.

* The pressure of a fluid in motion upon any body at rest is equal to the pressure of the same body with equal motion against the fluid at rest, and is as the square of the velocity. See Table C.

Fig. 8.

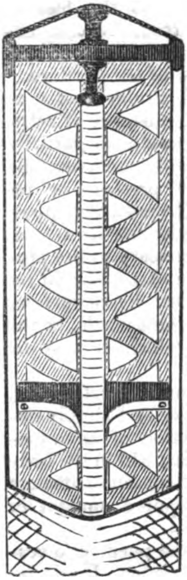


Fig. 3.

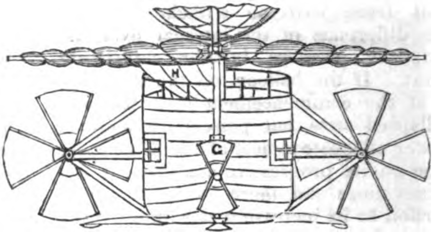


Fig. 4.

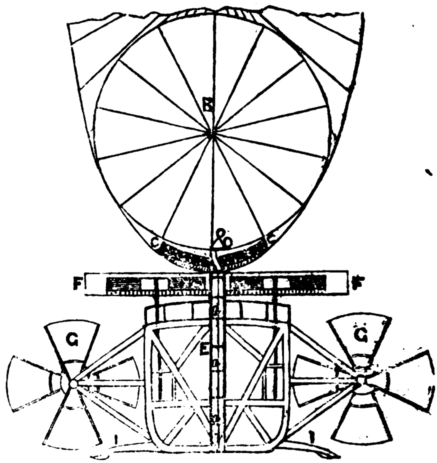


Fig. 5.

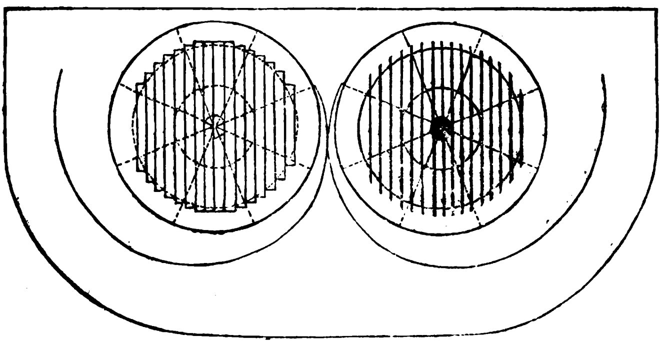
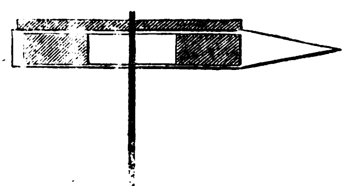


Fig. 6.



simultaneous horizontal reaction or propulsion. I use the term *blowing-fan*, for the present differs only in construction from the common blower in having but one supply aperture, with an enlarged or more open ejectment passage.

The antagonistic forces, or gravitating and anti-gravitating pressures of the fan, or contra-librato propeller, can be made to communicate, I presume, much impelling force to a horizontal plane or sail attached to the vessel, which, when inclined slightly from horizontality, will carry the former with it, being then in position for the force to operate. Let it now be supposed that a force of certain power and duration is applied to the inclined plane, alternately, on either side; and that, corresponding to this change of sides on the part of the force, an inversion of inclination of the sail takes place —an undulatory progression will be the result, the rate of speed depending on the resistance offered by the body, the amount of surface of sail exposed to the action of the vertical force, and the obliquity of the angle of inclination. If much vertical force could be manifested, either by the action of this double reacting propeller, or the variation of the temperature of the gas, when the magnitude of the recipient was great, or by both in conjunction, considerable speed, by the action on the sail, might be expected; but by the combined effort of the latter with the horizontal force of *all* the propellers, an aggregate velocity of large amount must of necessity be attained.

An exemplification of the undulatory progression may be made by any person, by simply stretching a silk handkerchief over diagonal laths, and securing it to them at the corners; a loop of string is to be engaged to one of the laths, and to this attached a small pendulous weight, in a manner to incline the handkerchief slightly from horizontality. The whole is now to be conveyed to some suitable elevation, from which it is to be dropped: if its descent be uninterrupted by obtruding objects, its fall will not be in a vertical, but inclined course, corresponding with the inclination of the plane or handkerchief. This experiment will fully exemplify the present theory, if it be only supposed that, after the descent of the body an equal force to the former weight is applied in the opposite, or upward direction, (the weight being removed,) and a continued alternating series of undulations performed, by successive reversal of the plane, attended with a repetition of the other conditions.

Having thus generally developed the theory of the means by which I think aerial navigation may be best effected, I beg now to submit the following general description of a machine suitable for the purpose.

Fig. 1 is a longitudinal external view of my aeronautic vehicle, which I propose to call THE PNEUMODROMON.

Fig. 2. Longitudinal vertical section of the same, exhibiting the mode of attaching the car to the gas-vessel by means of a compound tangent keel, laced through eyes or sheaves in the latter to a reticulated belt-work composed of webbing, embracing the envelope, or cemented to it.

Fig. 3. Stern view of the vehicle.

Fig. 4. Vertical cross section.

Fig. 5. Plan of a pair of horizontal double reacting, (reverso-ponderating,) and centrifugal propellers.

Fig. 6. Vertical lateral section of ditto.

Fig. 8. View of a portion of the perforated spar, with part of covering removed, of which the masts, yards, and framing are chiefly constructed.

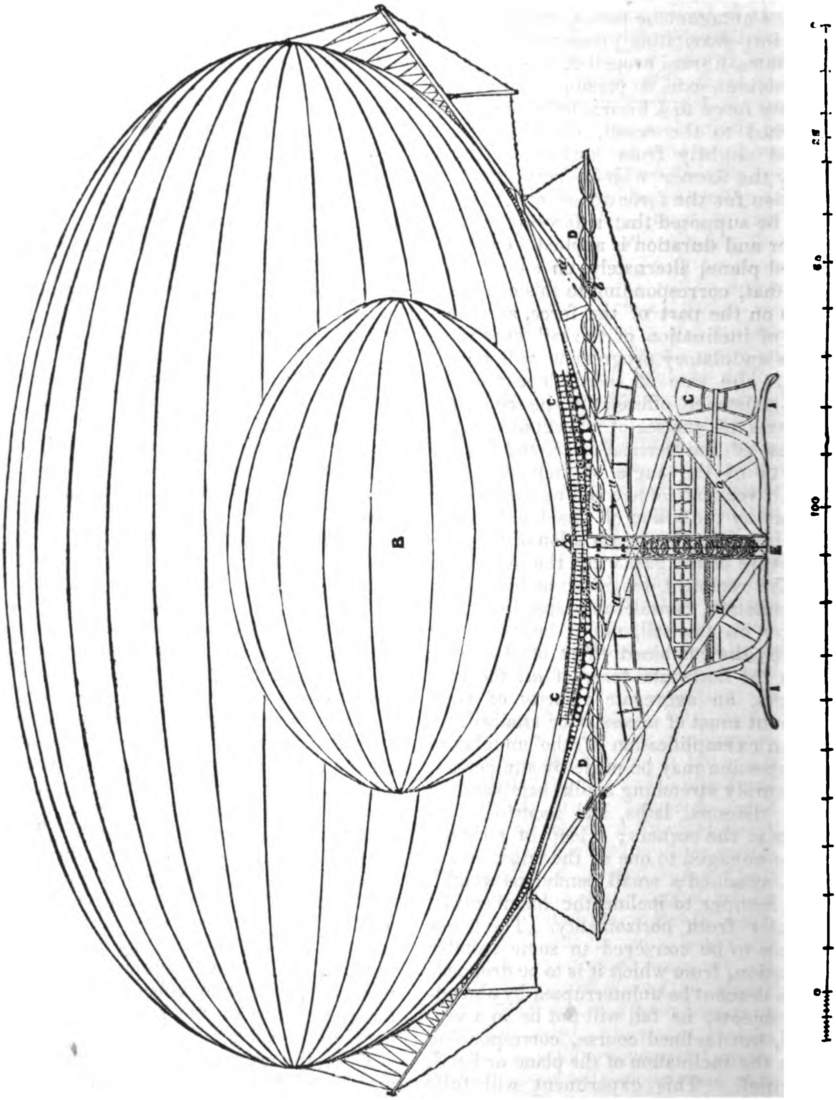
A A A, envelope, or gas recipient, strengthened by a net of broad and strong bands.

B, atmospheric compensating chamber, composed of a strong woven material of similar texture to the envelope, of capacity or volume equal to one-fourth of the latter, or rather more, and fitted with two pressure-valves, (communicating by flexible tubes with the external air,) of which a duplicate provision would be necessary for safety, in the event of either being accidentally deranged. The vessel may be supplied with air through the hollow upright mast, or principal post in the centre of the car, and could be wholly filled with air in a very short space of time, if required, by a condensing apparatus of my invention. The depletion is, of course, effected by the external pressure of the gas on it, or by opening the valve.

C C, the calorator, which consists of a series of thin metallic tubes, running horizontally along the bottom of, but not in actual contact with, the substance of the envelope, parallel with and supported by standards fixed to the keel, and entering the tissue through flat collars or rings, secured air-tight by jacketing of imper-

vious cloth. On this system of tubes, which should be a few inches apart, and of a small bore, are placed or strung a series of plates, ranging across the vessel, and thickly disposed. *a a a a*, keel and supporting frame to car, compound-

Fig. 2.



ed of a series of tangent spars to the suspensory body, which, for combining extreme strength and lightness might be constructed of hammered steel, perforated laminæ—feather-edged, or flanged with longitudinal right angular ribs—strengthened at intervals by knees—and the whole convolved by a thin metallic sheeting,

The plates, it is almost superfluous to observe, should be scarfed to each other, end to end, and gradate from greatest thickness at the base, to a tapering substance upwards, accompanying the corresponding diminution in breadth.

D D D, horizontal sails, by which the undulating progress is obtained. The chief, or main sail, or rather the two, side to side, are bent on to the horizontal tangent spar, and spread by yards, which latter are themselves suspended by the same spar; two triangular fore and aft sails are also carried by these yards and mast—the *after* sail being capable of shifting, or altering its angle of inclination (in a vertical plane), relative to the other sails in an upward or downward direction (by means of the joint *b*, which unites the two masts,) and by which, steerage, or tacking in a vertical plane is effected for the government of the undulatory sailing.

The whole of the sails, it will be seen, by the engravings, may be presented obliquely to the action of a wind on the beam, when a side or oblique wind prevails; thereby acting as an immense lee board, which would be indeed necessary (if that purpose were the *only* object of the sail,) from the circumstance of the thin medium of the air offering less resistance in counteracting lee way, or keeping the vessel to weather. The evolutions, or management of the sails in a wind of the above nature, requiring in a downward board or tack the same kind of inclination relatively, but laterally, which the corresponding longitudinal operation demands. For instance, when the wind is on the starboard, or right hand side of the vessel, and an ascending board or course obtains, the vessel itself, (carrying with it the sails, or communicating to them its own longitudinal position,) would have an upward inclination, whilst laterally, the latter would be inclined also upwards to the lee side. When the vessel is put on the downward board, the yards are oppositely braced. An example for the contrary wind to the one just supposed need not be worked out, the necessary manœuvres being sufficiently obvious. Sensible motion of these successive undulations (the angle of inclination being but slight, and the sweep of wave, as it were, long) would most likely be unfelt by the voyagers.

E, the car, which is built into the tangent keel in the manner represented by the sectional engravings, and roofed in a light manner, which answers also as a deck. A range of window lights is placed all round, and there is a floor or lower deck, dividing it into compartments; the upper for containing the engine, and accommodation for passengers and crew; the lower is the hold, for stowage of water, fuel, and stores. The sides and bottom, and even upper deck, if tubulated, would afford additional strength, form a good condensing medium, and give warmth to the interior, if wanted; while the internal lining might be fabricated of light basket-work, and this, if necessary, covered with a close hanging of felt.

F F, two horizontal centrifugal propellers, placed above the car, and below the gas vessel, the sail being removed in this part for their reception. The use of these propellers is for producing (conjointly by double reaction) a propelling force, and elevating or depressing momentum; the latter power being applicable to communicate motion through the sails, as already explained. The parts presented to the wind are tapered, or rather of a wedge form, as shown in the vertical section, fig. 6. These propellers are suitable to elevate and propel a flying apparatus of mine, which I will take an early opportunity of describing in the pages of this Magazine; though it is my opinion that all machines for navigating the air, without the use of a buoyant fluid, will never be of much practical utility.

G G G, spiral propellers for ordinary propulsion.

c c, band drums for revolving spiral propellers.

H H, vertical sails or rudders for lateral steerage. Most likely, in practice, one would be found sufficient, very little power being requisite for wearing the vessel round, and space for that evolution being *not at all confined*.

I I I I, spring fenders, projecting laterally from the bottom of the car, for buffingthe machine in descents, and promotingafter steadiment whileon the earth.

The *furnace* I would propose to be constructed for the combustion of *liquid fuel*, as being superior in safety, and economizing space and weight. One of this description I have devised, which I may be excused from now describing, as the right to it has yet to be secured, and which *is* devoid of danger of ignition of the gas. Liquid fuel would economize both weight

and stowage, because of its being free from extraneous earthy, or incombustible matter, so plentiful in all kinds of solid fuel. By the introduction of these furnaces, either more fuel might be carried, which would enable longer voyages to be made with a given power, or an increase of power might be obtained during the same given time. In fact, a virtual reduction of the size of the vehicle would be effected by it.

Regarding the *steam-engine:* — the lightest, strongest, and most powerful that could be had, weight for weight against others, should be employed. But, seeing the propellers are to be driven at a great velocity, perhaps a rotary engine, making rapid revolutions, would be preferable, as it would reduce intermediate gearing and weight, provided always one could be found sufficiently economical in consumption of steam. Anxious for the employment of the rotary principle, I have devised one of the kind, which I believe could be got up exceedingly light and powerful.

The high pressure principle in these arrangements would be beneficially used; the eduction steam to be, when wanted, passed through the calorator, so as to part with its heat to the gas, and on leaving this apparatus to be turned through the condenser.

The governing principles of this design having been thus explained, it remains now to ascertain how far the present project would be found available for realizing the objects and advantages of aerial transit. I will therefore endeavour to show, as far as our present limited aerostatic data will allow, the application of those principles; and shall select for that purpose from Table A, the 36th magnitude, as an example, it being the greatest sized body of the series which the strength of the proposed material is capable of sustaining, at a tension adequate to the preservation of its original form when subjected to the rude pressure of storms and tempests. It will be evident, by inspection of Table, A, that to insure perfect success to the object, our operations must be conducted on a scale of considerable magnitude, and we shall presently see that a seemingly fragile fabric is amply sufficient to sustain a tension of many tons. Sir George Cayley, in his valuable "Practical Remarks on Aerial Navigation," (published in the *Mechanics' Magazine*, No. 708, March, 1837, from which I have derived much information,) has shown, from experiments instituted for the purpose, that the double caoutchoucized cotton cloth of Messrs. Macintosh is capable of sustaining a tension of 2,500 lbs. per square yard.* By computation of the forces of the internal pressure necessary to withstand the effects of storms, (which by Smeaton's Table, C, is found to be 162 lbs. per square yard,) the result gives a limit to the size of the figure, whose body or envelope is composed of this adaptable material, to the above magnitude; taking the length of circumference, which, being 207,346 yards × 2,500 lbs., (sustaining tension of each lineal yard of the cloth,) is found capable of bearing a tension of 518,365 lbs.; while the periphery of the greatest vertical cross section is 113·1 yards × 2,500 lbs., supporting 282,750 lbs. The internal resisting pressure produced by dilatation of the gas to a degree equivalent to counterbalance the greatest outward force to which it may be subjected, (or 162 lbs. per square yard,) is ascertained by calculating the forces exerted on the areas of the greatest longitudinal and the greatest perpendicular cross sections at 162 lbs. on each square yard of the several areas;—for the largest is equal to 3166·733 square yards × 162 lbs. = 518,010·7136 lbs. pressure; and the cross section is 904·78 square yards × 162 lbs. = 146,574 lbs. pressure to which each section is individually sub-

* "The double-cotton Indian-rubber cloth, used by Mr. Macintosh in his manufacture of air-tight seats and cushions of various kinds, weighs very nearly 1 lb. per square yard, and will just sustain a tension of 2,500 lbs. per lineal yard, that is, if the yard of cloth were rolled up and used like a rope, it would sustain any weight less than 2,500 lbs. Of course, if used flat, as a portion of the surface of a balloon, it would sustain tension to the same amount. This cloth, when made to adhere to an adjoining breadth by an over-lap of one inch with the Indian-rubber varnish, is air-tight at the seam; and is to the full as strong in resisting tension as at any other part, as I have found by experiments carefully made for the purpose. Calculation proves that a condensation of one part in 120," (in the present case dilatation is substituted by which, if as before shown, a variation of temperature of 160° on Fahrenheit's thermometer can be obtained, one-fourth of the volume under ordinary circumstances can be dispensed with,) "will give it firmness sufficient to resist storms without affecting its form; and the cloth is known to be air-tight under much more intense condensation: surely, then, we can scarcely doubt the possibility of making such a balloon, or of inflating it by pumping, with pure hydrogen gas, setting aside at present all consideration of the *cost* of the experiment." The present figure, though differing in form from that of Sir G. Cayley is of nearly equivalent volume.

jected, being as much as could be with safety trusted. Before calculating the attainable velocity, and consequent proportional resistance thereon, it may be premised that aero-locomotion, to be ultimately of extensive service, or to come into general use as a medium for the conveyance of intelligence or transit of passengers, must present an advantage in point of speed superior to that furnished by other means already in use. If the general velocity were less than railroad, though greater than marine travelling, it would still be a valuable desideratum or adjunct; and, in the hands of science, for exploratory and other expeditions or observation, would hold a rank of the highest importance. In navigating the regions of the air, the circumstance should be strongly impressed on the mind, that currents and counter-currents are met with by the aeronaut at different altitudes; and it is firmly established by the inductions of science, and by experience, that the currents of the lower atmosphere invariably flow in an opposite direction to those of the upper strata. Hence, from these important phenomena a highly valuable advantage may be derived in the conduction of aerial transit, in profiting by a selection of the most favourable altitudes; so that, while doing so, in most cases (at worst) a side-wind would have to be opposed. Thus far the winds are in our favour, and court us to aero-navigation.

It is next to be found what resistance would be met with by the air—suppose a calm—and what amount of power it would be necessary to apply to a given surface to acquire a certain positive propelling effect or velocity. The *volumes* or *buoyancies* of spheroids increase in cubical proportion to their collective diameters; their *surfaces* only in the ratio of the squares of those diameters; and the *resistance* to the body is in proportion also to its surface. It is, then, clear from these differences in the ratios of *buoyancy* and *resistance*, that, by increasing the magnitude, we must at last arrive at a size suitable for sustaining machinery, sufficiently powerful for overcoming the resistance of a strong wind, or proportionably to increase the velocity when sailing under favourable winds.

In the spheroid chosen, I assume *the resistance to the figure equal to one fifth of that met by a plane equivalent to the area of the greatest cross section.* (Fig. 4.) This estimation, I expect, would be found in practice much above the actual value; but I believe it may be safely inferred, from analogous resistance to vessels in water, that the resistance in air would be considerably less than this amount.* The volume of the balloon, found under column 7, Table A, is equal to 50,667·725 cubic yards, the weight of which, in atmospheric air, is equal to 45 tons 16 cwt. 10·14272 lbs., and the same displacement in pure hydrogen (column 10), under same temperature as the air, = 3 tons 9 cwt. 44·8896 lbs.; but, if the latter can be rarefied 160° beyond atmospheric temperature, only 38,000 cubic yards will be required to be admitted at the lower temperature, whose weight of volume will then be 2 tons 12 cwt. 5·6688 lbs., leaving an actual buoyancy of 43 tons 4 cwt. 4·47392 lbs., which amount would be found sufficient to support the weight of powerful machinery and many passengers. Now, the resistance to the spheroid, assuming a velocity of 15 miles per hour, is equal to

Area of greatest cross section.		Pressure on 1 sq. yd., at 15 miles per hour.		Resistance.
904·78 square yards	×	9·963 lbs.	=	1803 lbs.

$$\frac{904{\cdot}78 \text{ square yards} \times 9{\cdot}963 \text{ lbs.}}{5} = 1803 \text{ lbs.}$$

* *Bodies of different shape* moving in a fluid (or which is the same in effect, supposing a current of fluid impinging against stationary bodies therein immersed) *present different resistances* to the fluid in which they float, according to their form—the volume or displacement of each figure being assumed equal. If a cylindrical body, terminated in front by an equilateral cone, move through a fluid in the direction of its axis, the resistance experienced is one-fourth, and if the body be terminated in front by a hemisphere, the resistance is one-half of that which would be experienced by the same cylinder if it were terminated in front by a plane perpendicular to its axis. A spherical body experiences about one-third of the resistance which is encountered by a cylinder. A sphere cut in halves and separated by the intervention of a cylinder whose base and length are each equal to a diameter of the former, experiences a diminution of resistance which, compared with that of a complete globe, is nearly equal to one-fifth of the latter.

Bodies whose head-ends are formed with curve lines have great advantage in respect to resistance over those formed with right lines. Increasing the length of a solid of almost any form by the addition of a cylinder in the middle greatly diminishes the resistance with which it moves, provided the weight in suspension continues the same.

and the power of engine required to attain such velocity is (the resistance) 1803 lbs. $\times$ 22 ft. per sec. $= \frac{39{\cdot}666 \text{ lbs.}}{550}$ which is equal to a power of 72 steam horses.

Then, if we estimate the surface of the propellers at one-eighth of the area of the greatest cross section, or $\frac{904{\cdot}78}{8} =$ 113, and the resistance to the spheroid $\frac{904{\cdot}78}{5} = 181$, the sum of these (= 294) results severally multiplied into the pressure of the wind (7·2 lbs., following sq. of vel. of the wind) on 1 sq. yard, at 12¾ miles per hour (into 18·7 ft. per sec.), the velocity with which the propelling power must advance beyond the desired velocity of the balloon; the engine must work, to impel the balloon at the velocity of 15 miles per hour, at (22 + 18·7) 40·7 feet per second, which requires the power to be increased as the first velocity is to 40·7 feet, or from a power of 7·2 to 133 steam horses; say, 140 horses for actuating all the propellers, and compensating condensing apparatus when required, at the above velocity. But if the dilatation of gas can be effected to the extent of one fourth of its original volume, a large force would be available for application to the horizontal plane, which would considerably increase the speed, in conjunction with the double horizontal fan-propeller, without expenditure of additional engine power. The amount of extra velocity by these means can only be truly ascertained by experiment; all the existing practical data with respect to the action impelling on oblique surfaces in air, being very imperfect. A guess may perhaps be ventured at another hundred horse power, assuming the use of two twenty feet fan-propellers.

Not to trespass further on your valuable space, I will shortly conclude, by answering by anticipation any objection that may be made on the ground of the difficulty of steadying so large a body during inflation. I think this might be readily met by providing a suitable hypethric erection, or circular walled building without roofing, but sufficiently protected from the wind by the wall being built very high. Around this station, which might be made large enough to contain a number of vehicles, the gasometers and gas-generating works could be ranged to advantage. The least expensive method of obtaining the purest hydrogen would, I believe, be by the decomposition of steam over iron turnings, &c., in apparatus properly constructed for the purpose. A design for which kind of apparatus I am prepared with, that I fully believe would be very economic on this large scale.

I am, Sir, your obedient servant,

J. S. Partridge.

Bankside, Southwark.
April 13, 1843.

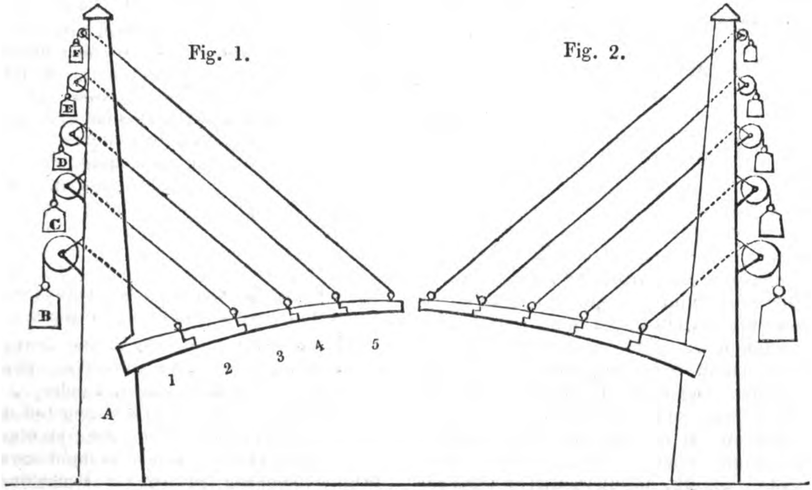
PRINCIPLES OF SUSPENSION BRIDGES—SCREW-CUTTING—AERIAL MACHINE.

Sir,—Several years ago, when sitting in my dining-room, 150 miles from this city, I saw a cat pass along a slender, almost horizontal bough of a young beech tree, to another tree in the same plantation. I thought the bough declined very little, considering the great comparative weight of the animal upon it; and if the slender end of the bough had been aided by any abutment, the depression would have been imperceptible. Here, thought I, nature furnishes a true principle of suspension-bridges.

Subsequently I met with Mr. Dredge's account of his suspension-bridge, which seemed generally to accord with my previously-formed notions on the subject. I then constructed a rough model, (a drawing and description of which I send,) and on coming to this place I went to look at Mr. Dredge's bridge over the Avon, and also at Mr. Motley's, drawn and described at page 293 of No. 1026 of your Magazine. My humble opinion is in favour of Mr. Motley's, on account of its being free from any swinging motion, which chains can never be, and with such motion there must be heavy wear and tear.

Let Nos. 1, 2, 3, 4, 5, fig. 1, represent separate loose blocks or compartments, forming half the suspended platform of a bridge; A, the main abutment; B, C, D, E, F, weights, each keeping by cord and pulley its respective block suspended or just balanced.

Now, it is true in practice, and I believe apparent in the sketch, that a moiety or portion of block 5 is borne by block 4; the other portion is kept from falling by the small weight F. In like manner, a portion of block 4, with its incumbent share of block 5, is borne by



block 3; the remainder is supported by the larger weight E. And the same may be said of the other blocks or compartments backward to block 1, which, with all its incumbencies, is partly supported by the main abutment A, and partly by the largest weight B, the whole being, or made to be, in equilibrio. It will further appear that the more elevated the arch, or peak of the whole platform, the more will have to be borne by the abutment A, and the less by the weights; and when the segment platform of fig. 1 is allowed to touch the segment platform of fig. 2, part of the whole weight of platform fig. 1 will be transferred to the abutment and weights in fig. 2; but this I pass by. So much for the bridge itself, or bough without the cat.

Now, let a load of, say one ton, be placed on block No. 1, part of this load (assume half of it) will be borne as before by the abutment A; the other half must be sustained by adding half a ton to the weight B, this process not at present affecting blocks 2, 3, 4, 5. Pass the load on to block 2, and then half a ton must be added to weight C, the remainder of the load will be supported by block 1; but, at the same time, part of the before added weight may be taken from weight B, as it has now only half a ton to sustain instead of a ton. The process or load thus goes on to block 5, adding to the foreweights, and taking away from the hinder ones.

To build this bridge, let compartment No. 1 be first pushed forward, or constructed with forethought, strength, and security, for bearing such weight as the whole remainder of the segment may lay upon it. This will then form a base for pushing onward compartment No. 2, and so on to the centre of the bridge, if it be thought expedient to build it without suspended or other scaffolding.

Change these graduated weights, pullies, and cords, for suitable tension bars of varying strength, with lockings and braces to render the whole as one piece, and you have a firm suspenion bridge, at a minimum outlay of material, which I am inclined to think is not the case with either Mr. Dredge's or Mr. Motley's.

If there be any fallacy in this reasoning of mine, for there is none in the model, I shall be most glad to have it pointed out.

Your Screw-cutter, at page 360, forgets, I think, that the *dies* do not cleanly *cut* a screw, but rather *squeeze* one, whence the variation in length. Lathe-cut screws would not, I presume, have the same defect.

Surely Mr. Henson's aerial machine

can be nothing more than a large parachute. Down! down! from whatever height it may begin; and if slowly, still down.

I remain, Sir,

Your very obedient servant,

J. H. Clive.

Bathwick Hill, Bath,
May 11, 1843.

CONSTRUCTION OF THE SERAPHINE.

Sir,—In your 1029th Number is a communication from Mr. Heineken, on the scale of the Seraphine, and as I have also made a few experiments on that instrument, or rather on an instrument constructed on the same principle, for experimental purposes, I hasten to put in practice my belief of the desirableness of a community of property in knowledge, by communicating one or two of the results—hoping, however, that I shall not be suspected of adopting that creed entirely from motives of self-interest, although I am but too well aware that I should, from having much less of all kinds of knowledge to teach than I have to learn, be greatly a gainer by its general adoption.

It may be remarked that the scale furnished by your correspondent is, as may be readily supposed, not the only one in use; that of the accordion is much smaller, and I have seen some seraphines in which the scale has been almost as small as it is in the accordion. On the other hand, they have been made much larger than Mr. Heineken's scale. I have, in a former article, stated that a larger scale affords more powerful tones, of better quality—that it is less reedy. If the tongues of Mr. Heineken's scale had their pitch raised an octave, and were increased in breadth about one-half, the tone would be much improved; but a much larger bellows would be requisite to afford a proportionate quantity of wind. A considerable improvement in the quality of the tone may be effected by forming the reeds or tongues much thicker at that part which is fixed; this diminishes the jarring, and consequent reediness of the tone. In the experimental instrument before adverted to, the tongues for the bass sounds are so thick, as not to vibrate sensibly for the first half-inch of their length, at the fixed end; consequently, the bass is much superior to that of the seraphine. But if this mode of forming the tongues be employed, it is difficult to make the treble notes speak quickly, unless the tongues be considerably longer than usual, to compensate for that part which has little or no vibration. After all, I feel compelled in justice to admit, that I never was able to obtain so fine a quality of tone, nor any thing like the rapid articulation of the bass of Mr. Myers' Eolophon, with the patent vibrators or reeds. The tone of the experimental instrument certainly was much superior to that of any seraphine which I have heard in private, especially in the bass; but I generally found it was good in proportion to its slowness, and that it lost in quality as it was made to speak more quickly, a fact which, I believe, is in accordance with the experience of all who have experimented on the free reed.

Mr. Heineken mentions seraphines of original construction, by Mr. Peckstone. Would Mr. H. be so kind as to fulfil his promise, by informing us amateurs in what the originality consists, if he can do so without breach of confidence. Perhaps by so doing he may become the instrument to stir up the "dry bones" of mere custom and imitation, which appear, with some exceptions, to be the general characteristic of London musical instrument makers, and infuse a portion of life into their almost soulless, carnal bodies.

I remain, Sir,

Very respectfully yours,

Alfred Savage.

16, Garlick-hill, Upper Thames-street,
May 4, 1843.

FALLING BODIES.

Sir,—I let fall a bullet, (say 5 feet,) in my drawing room, from my hand to the carpet—I let the same bullet fall in my garden from the surface of a pond, (also 5 feet deep,) to the bottom. The time occupied by the bullet in falling through the air, and through the water differs, because the medium of the one differs in density from that of the other. The different elevations of the drawing room and the pond from the mass of the earth, has some effect also on the falling body. The atmosphere differs in its density according to its distance from the earth, and I let the bullet (say of 5lbs. weight) now fall from the "mast 100 yards high" (see *Mech. Mag.*, pp. 360 and 390, current vol.,) and the vessel moving at the rate of 100 miles per hour, "the ball will alight on the deck

close to the foot of the mast," as, Mr. Editor, you remark in reply to your Oldham correspondent, which is sufficiently accurate for practical purposes. You have reserved ample space in your reply for slight variations, in only stating that the fall will be "close to the foot of the mast," you do not say that the point it strikes on the deck is truly a vertical point under the actual zenith of the centre of the ball when let fall; and your correspondent, Mr. Baggs, is not satisfied with your reply, and has brought his mathematics to bear upon the point. In doing this, no disturbing element should have been omitted, and you have added, with great propriety, that the latitude of the vessel must also be taken into account; and I may add, that, in the bullet's descent, it has to pass through a medium continually increasing in density. We are not now stopping to enquire whether the effect of this be or be not "practicably inappreciable;" it is a retarding agent, increasing in power the nearer the bullet approaches the earth, or the bottom of the mast. The earth's attraction (gravity) alone causes the bullet to approach the earth, and the power of gravity increases as the distance of the bullet from the earth diminishes; but the density of the air (that is, the resisting or retarding power) increases also, the nearer the bullet is to the earth. Now, Mr. Editor, will your mathematical friend, Mr. Baggs, or any other of your learned correspondents, calculate for your readers the time, in seconds and decimals, the bullet takes in falling the 100 yards, and further set forth distinctly, for every foot of the 100 yards, the exact period of time the bullet takes in passing the several feet respectively, distinguishing the time due to gravity, and the time lost by the retarding influence of the medium it falls through, continually increasing, as it does, in density, and consequently every foot offering more and more resistance to the falling body, which loss, of course, the bullet would not suffer in falling in a perfect vacuum.

He justly observes that the centrifugal force generated by the revolution of the earth on its axis increases in direct proportion to the distance a body is placed from the centre of the earth, and that this centrifugal force operates on falling bodies, and occasions them to descend "*a little*" to the eastward of the true vertical point. He adds, that it will form "*a gentle curve*" in its progress. Does he mean to say that at the middle of the descent (that is, at 50 yards) the bullet is farther from the true vertical line than it is either at the point of projection or at the point of rest, describing a bow-like line? Why must it curve at all—why not travel in a straight line, yet inclined more or less to the true horizon, forming therewith an acute angle by the line it describes in its passage? But to return. By his showing, it is evident that the disturbing force from centrifugal motion must vary and become less every instant that the bullet approaches the earth; and, may we not add, that the longer the bullet is suspended in a given space, and the longer it is exposed to the action of this centrifugal force, the greater will be its disturbing effects on such bullet, in deviating it from the true vertical line in its downward motion; that is, in the first foot of the falling bullet, the time occupied in the passage of the bullet through the space of one foot will be longer, and, at the same time, the centrifugal force greater than in subsequent like spaces. Will he calculate for us its true place in every foot of the 100 yards? and whether the line described be a curve or straight line, and why? also the several varying times required in passing the several respective feet, distinguishing the effects of the several disturbing elements, as before-mentioned; and also that due to the influence of the several degrees of latitude "between London and the equator," which, of course, (as you observe,) must be brought into the account, giving, as it does, "a varying surface velocity of no less than 477 miles." I am, Sir, Yours respectfully,

J. M.

Battersea, May 13, 1843.

DIFFUSION OF ODOURS.

Sir,—In a recent Number your Correspondent, X. P., inquires, whether it be a fact, that odours do not pass through glass, and what may be the cause thereof? Your answer is a very judicious one; and as you hint therein that the question is one of difficulty, and involved in obscurity, I beg leave to offer the following remarks on the subject. I incline to a hypothesis, suggested by that of your ingenious correspondent "Z." as to the constitution of the universe, namely, that ponderable organic matter is, by a mysterious process of nature, partially dissolved and converted into imponderable *effluvia*, combined or combining with the likewise imponderable ethereal and photic fluids; and that such a triple compound constitutes the various highly rarified *essences* or material spirits of odours as well as flavours, with both which *ponderable* elemental matter is again, under certain circumstances, *chemically* combined, and under others, only, more or less *mechanically* impregnated. Accordingly, I presume, that gases in particular when expanded by latent heat are apt to be so impregnated mechanically, thus accumulating the essences in question in the

centres of their vesicles, with consequent diffusion under atmospheric pressure. Thus the strong aromatic scents of flowers, fruit, essential oils, &c., would be volatile compounds of imponderable essences and ponderable gases, and such, I suppose, are the odorous matters which your Correspondent refers to. I think it quite natural that they cannot penetrate *through* glass in their pon derable state; but if confined in glass for a certain length of time, and the vessel be frequently exposed to the sunbeams or a heat of about 100°, I am inclined to doubt that the odour will be preserved, but presume, that a gradual decomposition will ensue, during which the ponderable particles of the odorous matter will partly condense and settle on the inner surface of the glass vessel, while the *odorous essence* will be found to have partially or wholly disappeared; and that even a partial vacuum will have formed in the bottle; so that when the latter is reopened at a temperature of about 60° a little air will rush in.

I am unacquainted with the experiments that have been made towards elucidating the question with reference to such premises as the above; and I would feel obliged to you for referring me to a good scientific source. If you should think these remarks to be useful, I shall thank you to allot them a place in your interesting columns; and remain, with sincere regard,

Dear Sir,
Your most obedient servant,
PHILO-Z.

London, May 2, 1841.

[We do not recollect a single good paper on the subject of odours—unless it be one by Professor Edward Davy, which appeared several years ago in Brande's "Journal of Science." We have not the work at hand to refer to the particular volume.—ED. M. M.]

CHEMISTRY AND THE CUSTOMS.*

The pamphlet of Dr. Ure, of which we gave a short passing notice two weeks ago, is well deserving of a more formal examination. Independently of the points of personal reputation involved in it, it contains much curious and valuable information—a good deal to laugh at, but more that is suggestive of grave reflection—food alike for mirth and melancholy. The question which it discusses is one affecting very large and important interests—the Integrity of the Revenue, Justice to our Native Manufacturers, and the Worth and Character of our British School of Chemistry.

The case is this. A cargo of eighteen casks was imported from New York, and entered at the Custom House, Liverpool, by Messrs. Tennants, Clow, and Co., as containing "Naphtha." Doubts being entertained of its genuineness, a sample of it was sent to Dr. Ure, the analytical chemist to the Board of Customs, to examine. Dr. Ure reported that it was not naphtha, but pyrolygneous acid, mixed with a large proportion of alcohol, or strong whiskey; that it "contained 70 per cent. of alcohol, of specific gravity 0·878 at 60 Fahr., which is 30 per cent. above spirit proof;" so that 100 gallons (for example) would contain the equivalent in spirits of 91 gallons, proof strength; and that the spirits, when distilled, might be "rendered quite palatable by rectification with potash, so as to be fit for making English gin." The goods, in consequence of this report, were ordered to be "detained for being entered under a false denomination." The importers, Messrs. Tennant, Clow, and Co., remonstrated, and produced to the Board of Customs two counter reports, one from Professor Graham, of the London University College, styled by them "*the first chemist in this kingdom;*" and the other from Mr. David Waldie, chemist to the Liverpool Apothecaries' Company, both in direct contradiction of Dr. Ure's report—Professor Graham affirming that the liquor in dispute contained "*no pyrolygneous acid,*" was "*not alcohol, nor convertible by any means whatever into alcohol, nor ardent spirits;*" and that "so far from 91 gallons of spirits of proof strength being obtainable from it," as alleged by Dr. Ure, it "did not contain *any alcohol* that could be separated from it, and used in making English gin, by distillation with potash, or any other process whatever;" and Mr. Waldie certifying that he could find no "evidence of the presence of alcoholic spirit;" that the liquor consisted "only of pyroxylic spirit,

* "The Revenue in Jeopardy from Spurious Chemistry." By Andrew Ure, M.D., F.R.S., &c., Analytical Chemist to the Board of Customs, pp. 36, 8vo., Ridgway.

or wood naphtha;" and was "not a drinkable spirit, and could not, by any chemical process, be made a drinkable liquid." And here ends *Act the First*, with the question raised of "*Who is in the right?*"

Act the Second opens with Dr. Ure in profound amazement at the reports of his brother chemists, and busy in his laboratory re-testing the liquor in dispute. The results of the Doctor's further experiments are shown in the following Report to the Commissioners of Customs, of date January 7, 1843.

"In compliance with the request you made me yesterday at our consultation in your office upon the naphtha imported at Liverpool, which I examined on the 22nd of November last, by desire of the Hon. Commissioners of Customs, I have now the pleasure to submit to you the following justification of the certificate I then granted, which will serve to refute the counter-certificates since furnished, as you write me, by a Professor and a practical Chemist:—

"When two liquids are equally volatile, as is the case with alcohol and naphtha, or wood-spirit, it is utterly impossible to separate them completely by distillation, or by any direct methods, and this fact is no doubt well known to the compounder of this spurious naphtha. Surely no man, even moderately versant in Chemistry, would presume to deny the existence of alcohol in the said naphtha, because, forsooth, the two fluids are inseparable by distillation. In like manner, when lead and tin are combined, as in solder, it is impossible to separate them by fusion, because they melt together; but they may however be most easily parted by the action of nitric acid, which converts the tin into an insoluble oxide, and the lead into a soluble salt, and then the two metals may be perfectly separated by mere washing with water, and the quantity of each exactly ascertained, from the known composition of tin oxide and nitrate of lead.

"Thus, also, when alcohol and naphtha are mixed, we must have recourse to an indirect but a quite accurate method of parting them, and estimating the proportion of each in the mixture. In the present case, however, that is hardly necessary, since, on rectifying the spurious naphtha by distillation with quicklime, I could distinguish plainly, by the taste and smell, the presence of alcohol in very large proportion in the purified spirit.

"1. When alcohol of from fifty to sixty per cent. over-proof is mixed with its own weight of sulphuric acid, and properly distilled, it affords the fragrant liquid well known by the name of ether or sulphuric ether, and when the distillation is continued too long, the residuum in the retort becomes black, thick, and finally froths up with such impetuosity, as to be projected out of the vessel, though this be of fifty times the capacity required by the liquid before its intumescence. The process must, therefore, be well watched, and the heat withdrawn, some time before this phenomenon occurs.

"100 parts of absolutely pure alcohol yield 80·6 parts of ether, by losing merely 19·4 parts of the water combined in the elements of alcohol. See *Liebig's Organic Chemistry*, i., p. 315.

"When wood-spirit (wood-naphtha) of the same strength is treated in like manner, and distilled along with sulphuric acid, it affords not a LIQUID, but an AERIFORM product. 'Methylic ether,' says Professor Liebig, 'is prepared by distilling a mixture of equal volumes of concentrated sulphuric acid and wood-spirit. The *gas* which is disengaged, is to be passed first through milk of lime, and then through several tubulated bottles filled with water. This compound is a colourless gas, possessed of an agreeable ethereous odour. A cold of 16° below zero, of the centigrade scale (29° Fahr., below the freezing point of water) does not render it liquid.'—*Chimie Organique*, vol. i. p. 540.

"Berzelius says, 'Oxide of methyle or ligneous ether (made as above described) is a *gas* which does not condense in the receiver, but which should be collected over mercury. It is a colourless gas, which does not condense at 16° under 0° cent. As the operation of distilling the mixture of wood-spirit and sulphuric acid advances, the mixture becomes yellow, brown, and at last black, but *without thickening or frothing up, as happens when alcohol is treated in the same manner.*'—*Traité de Chimie*, vol. iii. p. 403, of the French translation by Valerius, Brussels, 1841.

"3. I rectified the said naphtha by repeated distillations; first, by itself to separate the pyroligneous acid (which was obtained in very measurable quantity), and then with quicklime. The volatile spirit thus procured had a specific gravity of 0·839, and resembled alcohol more than naphtha. I then treated it, as above prescribed, with sulphuric acid, when it yielded a fine fragrant LIQUID sulphuric ether, and nearly in as large a quantity as the same volume of alcohol could have done. A very little ligneous or methylic ethereous gas also appeared, and passed off through the water of the safety-tube of the receiver. Three fluid ounces nearly of ether were obtained. On

continuing the heat, after the receiver was removed, the materials in the retort on the sand-bath became thick, black, frothed up, and were projected out of the vessel with great force. Thus, by the product of fine liquid ether, and the intumescence in the retort, two infallible proofs of abundance of alcohol in the said naphtha are obtained—proofs which will be recognised in every chemical court of Christendom.

"It is my opinion that the contraband article in question will make as good ether as the best spirits of wine, because the minute wood-spirit, or pyroligneous portion flies off in the form of a gas during the etherefication. Hence its clandestine importation under the false colours of a spurious chemistry would prove a serious detriment to the spirit revenue, as well as to the honest distiller, rectifier, and manufacturing chemist.

"Finally, I have analysed the pyroligneous acid residuum of the first distillation of the said naphtha, conducted by the heat of a water bath, and I found that four fluid ounces of it saturate with a lively effervescence as much carbonate of potash as two fluid ounces of ordinary vinegar, or 5 per cent. of real acetic acid, could have done. Here is therefore abundant evidence of acid, notwithstanding the Professor's counter-certificate.

(Signed) "ANDREW URE."

Could the verdict of "every chemical court in Christendom" have been here taken, there would doubtless have been at once an end of the matter; for, to say nothing of the satisfactory evidence which this Report contains of the presence of large quantities, both of pyroligneous acid and of alcohol, the product of ether from the suspected liquor was an incontestible proof of its alcoholic nature, *genuine naphtha being a substance from which it is impossible to obtain ether*. But as Chemical Courts, like others, are not of immediate access, even to Royal Commissioners of Customs, the action of the piece pauses for a time; the Board's "Analytical Chemist," vindicated and exultant, and the "first chemist in the kingdom," with his apothecary—associate Waldie, convicted, to all appearance, of most ludicro-lamentable incompetency.

Act Third opens with the sun in Pisces—scene the Royal Mint—Professor W. T. Brande *loquitur*.

"Royal Mint, February 2, 1843.

"Sir,—I beg to acquaint you, for the information of the Commissioners of Customs, that in compliance with their wishes, I have carefully examined the sample of wood-naphtha forwarded to me with your note of Saturday last; and that, in my opinion, it is not mixed with alcohol or spirits of wine.

"It is a matter of great difficulty to determine the entire absence of minute quantities of alcohol in wood-spirit; but the result of my experiments upon the present sample induces me to believe, that if there be any alcohol in it, the quantity is at all events very small, and not such as to admit of its being again separated for any fraudulent purpose; and I presume there can be no other temptation for the addition of alcohol in these cases.

"If you think it worth while, I can send you the specimens of the pure wood-spirit which I have extracted from your sample, and which have none of the characters indicating the presence of alcohol.

"I remain, Sir, your faithful servant,

(Signed) "WILLIAM THOMAS BRANDE.

"My charge on the present occasion is one guinea."

How strange! Another learned professor—chemist to the Royal Mint, and chemical authority of we know not how many other public establishments besides—he, too, positively declares that he can detect no alcohol where Dr. Ure found it in abundance, and affirms most confidently that, "*if* there be any alcohol in it, the *quantity is, at all events, very small, and not such as to admit of its being again separated for any fraudulent purpose!*" The Commissioners of Customs, apprehensive apparently that, as the Royal Mint professor charged only "one guinea" (!!!) for his advice "on the *present* occasion," he might possibly have taken proportionably little pains with the case, requested to know by what series of experiments (if any) he had arrived at a conclusion so much at variance with Dr. Ure's, and to explain, if he could, the discrepancy between them. The following is the Professor's reply:—

"Royal Mint, February 10, 1843.

"Sir,—I beg to acknowledge the receipt of your letter of this date, enclosing a copy of Dr. Ure's Report [of 7th January], and adverting to the discrepancy between our opinions respecting the sample of wood-spirit

lately reported upon by me, and the consequent dilemma in which the Board of Customs is placed. I request you will assure the Commissioners that I did not found my opinion upon the mere endeavour to separate alcohol by distillation, but upon the following experiments :

"1st. I distilled a portion of the sample, and separately collected the first, second, and third portions, which passed over, in none of which could I discern any distinct proofs of the presence of alcohol.

"2nd. I rectified portions of the sample over lime and animal charcoal, and the products were such as might be expected from wood-spirit, and afforded no evidence of the presence of any tangible quantity of alcohol.

"3rd. I mixed a portion of the sample with sulphuric acid, and heated the mixture in a retort connected with the pneumatic apparatus. I obtained none of the ethereal products of alcohol, nor could I procure any olefiant gas.

"Under all these circumstances, I thought and still think myself justified in making the report which I had the honour to transmit to the custom-house on the 2nd instant. Should it be the wish of the Commissioners, I will carefully repeat the experiments I have described, and subject the sample, *if possible*, to more rigid examination. But, on the whole, I would venture to suggest the propriety of submitting the question to some third chemical authority.

"I have the honour to be, Sir, your obedient servant,

(Signed) "WILLIAM THOMAS BRANDE."

Of experiments it will be seen there was no lack ; the Professor had well earned his guinea fee—provided always, of course, that the experiments were good for anything, on which point the reader shall presently have the Professor's own opinion to guide him in his judgment.

Act Fourth shows the Commissioners of Customs confoundedly perplexed — still strong in their reliance on the correctness of their "analytical chemist," but naturally puzzled to account for the conflicting statements of his brother professors. Once more they place the whole matter in the hands of Dr. Ure. And, to exclude all possibility of error on account of difference in samples, the Doctor is supplied this time with eighteen bottles full of the pretended naphtha, one taken from each of the eighteen casks detained. As, however, the *truth* of the statements in his former reports had been questioned—for to that the counter certificates amounted — Dr. Ure, before touching the eighteen samples, very prudently resolved to call in the aid of another gentleman, "who should be at once an unimpeachable witness as to his results, and a skilful coadjutor in the operations." He accordingly procured the services of Mr. Maurice Scanlan, "well known to the chemical world as being the author of the only discovery of consequence made regarding naphtha by any British chemist;"* and who, moreover, "had had much experience in the manufacture of ether, and in the rectification of alcohol and wood naphtha upon the commercial scale." After being diligently occupied with experiments on the suspected liquor for three weeks, Messrs. Ure and Scanlan made the following joint report to the Board of Customs. We give it at length, as exhibiting a beautiful specimen of refined and correct analysis :—

"On Monday morning, Mr. Scanlan and I commenced our analytical operations. We found all the sample bottles to contain a liquor, apparently the same, having a specific gravity of 0·944 in general—one was 0·942, and three or four were 0·948. This trifling difference arose from slight variations in the quantity of pyroligneous acid which had been added originally to the alcohol for the purpose of disguising it. They all had the sour smell of crude vinegar, and reddened blue litmus paper very strongly.

"We subjected half a gallon measure, taken from five of the bottles indiscriminately to distillation by the heat of a water-bath, as a preliminary experiment, and obtained a spirit of specific gravity 0·901, or 14·67 over-proof, while an acidulous residuum was found in the still, which was saturated with effervescence by crystals of soda, and indicated one per cent. of real acetic acid in the original liquor, equivalent to twenty per cent. of excise proof vinegar. The above experiment furnished eighty-one per cent. of proof spirit out of the gallon. Some of this spirit was rectified along with quicklime in a glass retort, by the heat of a water-bath, whereby its specific gravity became 0·832, or 58·63 over-proof.

* The discovery referred to is that of the beautiful crystalline body called pyroxyline, or pyroxantine, (to indicate its pyroxylic origin and yellow colour,) which Mr. Scanlan was the first to extract from rough wood naphtha.

"A portion of this spirit was mixed with its own weight of sulphuric acid (oil of vitriol), and distilled with proper precautions by the heat of a sand-bath, when there was obtained an agreeably smelling ether, in about the same quantity as pure alcohol, of the same strength, would have yielded. This fluid, on being rectified in the usual way, afforded a fine ether, of specific gravity 0·752; a lightness perfectly decisive of the perfection of the ether, and consequently of the spirit from which it was formed, being nothing else than alcohol.

"Having made these incipient trials, we proceeded to operate on a larger scale, and distilled a gallon of the Liverpool liquor in a still mounted with a rectifying apparatus of my own invention. The pyroligneous acid was saturated beforehand with quick-lime, and then the clear filtered liquor was subjected to distillation over a naked fire. The spirit which came over was again rectified with more quicklime, in a glass apparatus, by the heat of a water-bath, when it came over of a specific gravity 0·8268, or 61 over-proof. Spirit of this gravity being well adapted to making ether, a proper proportion of it was taken along with sulphuric acid, and submitted to the process of etherefication in Bouillay's continuous method, as described in my Dictionary of Arts, p. 442. Ether came over most abundantly through Liebig's glass condenser, into a glass receiver, furnished with a safety-valve. The ether was characterized by its peculiar striæ or lines of fluid down the sides of the globular receiver, as also by its cool refreshing fragrance. No less than twenty-six fluid-ounces, apothecaries' measure, were obtained of an ethereous liquid, of specific gravity 0·787, which, on rectification, became of specific gravity 0·742, boiled under 100° (Fahr.), and amounted to fully twenty ounces measure, being a quantity about as great as the same quantity of alcohol of the purest kind would have yielded. This ether is lighter than the best standard ether of the Pharmacopœia, sold at the Apothecaries' Hall, London, therefore finer, and certainly as fragrant, and fully more volatile.

"This sample of ether, of about a pint measure, was examined at my request, by Mr. Morson, of Southampton Row, and Mr. Bell, of Oxford Street, both competent judges of the article, who found its specific gravity to be 0·742, and pronounced it to possess all the physical properties of sulphuric ether.

"The sequel of the ether distillation furnished the usual liquid products of the etherefication of alcohol along with olefiant gas in great profusion, characterized by its burning with a white flame, like that of wax candles, and by its being condensed on admixture with chlorine gas into chloride of carbon, the oily looking liquid from which it derive its familiar name.

"I have found that when ten parts of wood-naphtha are mixed with ninety parts of alcohol, each of moderate strength, and the mixture is treated with sulphuric acid as above, it does not afford any good genuine ether, but a peculiarly pungent offensive fluid, proving that the spirit drawn out of the Liverpool naphtha must contain little or no real wood-naphtha, but that it owes its peculiar taste and flavour to the pyrogenous oil of the wood vinegar, of which a few drops suffice to contaminate a gallon of good sweet alcohol.

"Sweet spirit of nitre is another product of alcohol, consumed in vast quantities in the United Kingdom, and which cannot be formed at all with wood-spirit naphtha. Mr. Scanlan and I followed the prescription of the Pharmacopœia, and obtained the full quantity of sweet spirit of nitre from the rectified Liverpool liquor, just as if we had used a like proportion of alcohol. The sp. gr. of this spirit was only 0·842=53·7 per cent. over-proof, while that of the commercial article is 0·850=49·1 over-proof.

"We have also prepared a good drinkable gin, which persons accustomed to that beverage have relished very much. It was made with the Liverpool naphtha rectified with potash, as is customary in the compounding of cordials. Samples of the ether, sweet spirit of nitre, and the gin, accompany this report.

"I have submitted a sample of the naphtha so rectified to Mr. Bowerbank, one of the most extensive and skilful rectifiers in London; and I take leave to hand in his report herewith, which I consider also a conclusive evidence of the said naphtha being alcohol.

"Having thus proved the alcoholic nature of the article, Mr. Scanlan and I next made a careful experiment to determine its exact amount, and that of the pyroligneous acid with which it was disguised. We distilled a gallon of the Liverpool liquor previously neutralized with lime, and obtained at one operation, by means of my rectifier, a spirit of 37·46 per cent. over-proof, equivalent in quantity to eight-tenths of the whole gallon in proof spirit, or 80 per cent. The residuary liquid, pyrolignite of lime, was decomposed into acetate of soda by crystals of soda, of which 3000 grains were required, indicating 1083 grains of real acetic acid, equivalent to about 45oz. measure of vinegar, excise proof, or thirty per cent. of the original liquor. Thus the Liverpool pretended naphtha consists of seventy parts alcohol, 14·3 over-proof, and thirty of pyroligneous acid.

"I now proceed to describe the researches we made into the properties of the several kinds of wood-naphtha now in the market, with the viewing of ascertaining the best criteria for distinguishing that fluid from alcohol, and consequently for discovering directly whether any sample of naphtha be illicitly compounded with alcohol, or be genuine.

"With this view, I procured from Messrs. Hill of Deptford, whose chemical works I am well acquainted with, a quantity of their rectified wood-naphtha, and also of the rough naphtha as first drawn off by distillation from the pyroligneous acid of their own manufacture.

"We rectified in my still, a gallon of their genuine rough naphtha, and found it to exhibit all the phenomena characteristic of this fluid; viz., boiling at a temperature fully twenty degrees below that at which alcohol-wash of the same gravity boils, and exhaling the peculiar smelling vapour of aldehyde, most offensive to the nose, and causing the eyes to redden and to weep. When thus distilled, it agreed in its properties with their rectified wood-naphtha. The fluid is colourless, has a peculiar, somewhat offensive odour, exhales, at a moderate warmth, a vapour very painful to the eyes, and, therefore, much dreaded by the hatters, who used to employ it in large quantities for dissolving their so-called gums, or shellac and sandarac. Hence there is a very strong temptation to introduce in its stead smuggled alcohol, slightly disguised, which does not injure the eyes, and is, moreover, a far better solvent of the gums. The pyroxylic spirit of Messrs. Hill is almost the only one that I have been able to meet with on sale in this country, which I think to be truly genuine. Other samples consist, more or less, of alcohol, illicitly introduced to the great injury of the revenue.

"Genuine wood spirit has the following distinctive characters: 1. When rectified naphtha, of specific gravity of 0·870, such as Messrs. Hill send out for sale, is distilled along with a large quantity of unslaked powdered quicklime, in a retort plunged into boiling water, the spirit comes over with its gravity unchanged; whereas, if genuine alcohol, or the spirit from the Liverpool naphtha, be distilled in the same way, each of these is alike concentrated, so as to be obtained nearly free from water, and of a gravity under 0·800, or 70 per cent over proof, and of the temperature 60° (Fahr.) Here, then, is a most remarkable difference between alcohol and wood spirit; one which of itself demonstrates the Liverpool liquor to be alcohol, and not naphtha; for did it contain even 5 per cent. of naphtha at the original dilution of the liquor, it could not be concentrated by the heat of boiling water with quicklime to the above low gravity. Wood-spirit, thus seems to possess a greater affinity for water than alcohol—a fact, of which another evidence will be presently adduced.

"2. When alcohol is reduced with water, the mixture undergoes a condensation of volume, so that 100 gallons of strong alcohol mixed with 50 gallons of water, do not occupy the space of 150 gallons, but a less space, proportional in a certain degree to the strength of the alcohol. Upon this fact, the excise tables of alcohol are constructed. Thus, when alcohol, of specific gravity of 0·832, or 58·6 over-proof, is to be reduced to proof, or 0·920, 100 parts of it in volume are to be diluted with water till the mixture, at 62 Fahr. occupies the space of 158·6 measures.

"The spirit from the Liverpool liquor agrees exactly with alcohol, in this respect, but both differ from wood-naphtha, which suffers a greater penetration of parts, and condensation of volume by dilution with water, so that 100 parts of specific gravity, 0·832, made to occupy 158·6 measures, by the addition of water, form a mixture of specific gravity 0·927 or 0·928, at 62° Fahr. Even the genuine naphtha of specific gravity 0·870 or 36·12 over proof, reduced with water till 100 measures become 136·12, has a specific gravity of 0·927, whereas alcohol and the Liverpool spirit so treated, have the specific gravity of 0·920, or excise spirit proof.

"3. The boiling temperatures of alcohol and genuine wood-spirit are remarkably different, and afford therefore excellent criteria for distinguishing the two fluids. Hill's naphtha of 0·870 specific gravity, boils at 144° Fahr. when heated in a small flask or matrass by means of a water-bath. If it be concentrated to the strength corresponding to specific gravity 0·832, it boils at 140° Fahr. Alcohol of specific gravity 0·870, boils in the same circumstances at 180°, and of specific gravity 0·832, at 171°. 5′ Fahr. The spirit from the Liverpool liquor agrees with alcohol in its boiling points at the several degrees of specific gravity, but differs entirely from naphtha in this most characteristic feature. If ten per cent. of naphtha be mixed with alcohol, each of specific gravity 0·870, the boiling point of the alcohol is lowered at least six degrees of Fahrenheit's scale. Upon this physical principle, it is clearly demonstrable that the spirit in the Liverpool liquor does not contain five per cent. of wood-naphtha.

"The spurious naphthas in the market are characterized by two features; first, their

low specific gravity; second, their high boiling points. Some of them have a gravity of only 0·822, others of 0·827. Now, as it is impossible to concentrate real wood-spirit to this pitch, by any ordinary manufacturing means, while alcohol may be without much difficulty so concentrated, a suspicion naturally arises of the illicit introduction of alcohol into a liquid sold at a price sixty per cent. at least under that of alcohol. This suspicion becomes a certainty on referring to the boiling points and other means that have occurred to me. The temperature at which these very *light* naphthas boil, is *higher* by at least 8° Fahr. than that of the much heavier and more watery naphtha of Messrs. Hill. One naphtha of specific gravity of 0·8216 boils at 152°, while Hill's genuine wood-spirit of 0·832 boils at 140° Fahr. By compounding alcohol and genuine naphtha, fluids are formed with boiling points like the above spurious or fraudulent naphthas.

"4. When genuine naphtha is treated with its own *weight* of sulphuric acid, as in the process of etherefication, the phenomena and products are quite different from those with alcohol and sulphuric acid. White fumes are exhaled most abundantly, while a gas is disengaged that burns with a faint blue flame. An acidulous liquor is found in the receiver, which being neutralized with potash, and re-distilled, affords a liquid of specific gravity 0·911, possessed of a peculiar pungent spicy odour, and resembling coal-oil in being immiscible with water. Here are sufficient proofs that real wood-spirit can furnish with sulphuric acid nothing in any respect resembling ether.

(Signed) "ANDREW URE,
MORRIS SCANLAN."

The reality of the sophistication was thus at length set at rest, and

Act Fifth and last exhibits, with very exact poetical justice, Truth and Ure triumphant, and Error, Graham, Brande, and Co. covered with confusion and shame. "First Fiddle" slips off behind the scenes, with 1st. 2nd. and 3rd. Smugglers after him, and is seen no more; the Royal Mint Professor, with a redeeming candour, steps forward and acknowledges that he was all in the wrong. ("I now write to you to acknowledge my error * * * I have assured myself of the possibility of obtaining alcohol, and, of course, ether, from the same spirit." March 31;) and the hero of the piece thus expatiates, to an admiring audience, on the moral which it teaches :—

"Nothing can place in a juster point of view the lamentably low condition of organic chemistry in England than the fact of two of the most prominent professors of the science in London having proved, by formal public declarations, made after deliberate experiments, that they are unable to distinguish alcohol from wood-spirit—nay, that alcohol merely tainted with pyroligneous oil is *not alcohol*, but genuine pyroxylic spirit. What will the chemists of the Continent think of this remarkable ignorance, or want of skill? Though, indeed, they must be somewhat prepared for such a phenomenon, since, among the thousand brilliant discoveries made within the last seven years in organic chemistry, *not one of any note can be traced to an English professor;* several of them, however, have good incomes, with well appointed laboratories and instruments of research assigned to them, at the public expense, for the cultivation of the science."

Aye, what will the chemists of the Continent think of it? Neither our "First Fiddle" nor our second, able to detect what the merest tyro of a foreign laboratory would probably discern in an instant! Ah! those "good incomes," those "well-appointed laboratories and instruments of research," supported "at the public expense"—is it not all owing to them, and to their damping influence, that our "fiddles" are so much out of tune? Mr. Babbage would say "no," and call for ribbons and garters in addition; but Liebig would bid us reconcile, if we can, such abundance of means with so deplorable an instance as the present of want of knowledge and skill. Men of a keener insight into human nature than either would, perhaps, contest the *reality* of the supposed want of knowledge and skill, and remind us that there are such motives to wrong-doing as love of lucre, with its proverbial blindness and temerity, and envious rivalry, prone to every sort of meanness—such things, in short, as Guinea Fees, and Purchased Certificates, "to damn another's fame, or raise one's own." Has not Professor Brande, himself, recorded it as a historical fact, in his *Manual of Chemistry*, (Edit. 1836,) that "articles are imported under the name of pyroligneous ether, spirit, &c., *which are most suspiciously* identical with alcohol, and which, if not closely examined, *may lead to serious frauds*

on the revenue, and that strong alcohol, disguised as to smell and taste, as in these respects to resemble pyroxylic spirit, has already been found in the market!" How then could he be serious in scouting, six years afterwards, the notion of such frauds being practicable? Was it not, moreover, an English professor, resident within something less than a hundred miles of the Royal Mint, who publicly certified that *choke-damp*, (carbonic acid gas,) the victims of which are counted by thousands, and tens of thousands, including among the number the unhappy son of the illustrious Berthollet, might be breathed with impunity, providing only it were generated by a Joyce's patent stove! What is there after that, in the way of opinion and certificate, which "the guinea fee" might not be expected to extract from a London chemical "First Fiddle?" Has not the hireling character of the English chemical school been the subject of rebuke, even from the judgment seat? Who can forget the memorable declaration of Chief Justice Dallas on the two days' trial as to the cause of the fire in the sugar-house of Severn and King, "when the chemists of the metropolis, banded and pitched against each other like two troops of prize fighters, swore point blank to opposite results from like experiments." "*These two days are not days of triumph, but days of humiliation for science.*" Mr. Brande, in his History of Chemistry, which forms one of the preliminary treatises of the *Encyclopædia Britannica*, uses a felicitous phrase to describe certain eras in the progress of the science—he calls them "*red letter days.*" May we hope that he will not forget, in his next edition of the Treatise, to add that it has had in England its *black letter days* as well? And should there be room for an example or two, we trust he will not be restrained by any feeling of modesty from giving to his own and "First Fiddle's" discoveries in wood naphtha that prominence which they deserve.

It must, we think, appear to every impartial reader of the present pamphlet that Dr. Ure was exceedingly ill-used by his brother professors, and that they richly deserve the exposure which they have received at his hands. It was not a matter of opinion, such as men are allowed to differ upon, whether there was alcohol and ether in the suspected liquors or not, but a matter of fact, authenticated by the positive assurance of Dr. Ure, that he had actually extracted both substances from them in abundance; both Professor Graham and Professor Brande were fully apprised that Dr. Ure had reported the fact to be so; and before they ventured to contradict him so flatly as both did, they should, for their own sakes, for Dr. Ure's sake, and for the sake of their common science, have sought a conference with Dr. Ure, and asked him to verify before them his experiments and results. On Dr. Ure's part there appears to have been no want of proper feeling—no attempt made, nor any wish whatever entertained, to *entrap* his brother professors. On the contrary, he went so far in courtesy (too far, some may think) as to *invite* them "to come and see the various alcoholic products" he had obtained from the spurious naphtha ("a pint of fine ether among the rest"); but, as if their business was with anything but truth, they both, on one weak pretext or other, declined the ocular demonstration tendered to them. "First Fiddle" had been *feed* to certify that the suspected liquors contained neither pyroligneous acid nor alcohol in quantity sufficient to be separable for fraudulent purposes; and having so certified, he seems to have thought that he was *functus officio*. Professor Brande was employed by the Board of Customs to report the truth only; but, because his imperfect modes of experimenting gave results wholly different from those of the Board's chemical adviser, he was delighted, and (till subsequently goaded to it) would enquire no farther. '"*My* charge on the *present* occasion is one guinea," and for that I have given you three laborious analyses; while your analyser in ordinary charges two guineas for each analysis.' (See Dr. Ure's Preface.) Alas! alas! on what days of competition and cheapness have we fallen! Cheap jewellery, cheap champagne,

cheap haberdashery, cheap tailoring, cheap furniture, and now, at last, cheap chemistry! Price the only criterion and intrinsic worth of no account!

After the question as to the genuineness of the eighteen casks imported by Messrs. Tennant, Clow, and Co. had been disposed of by the proceedings before related, no less than eleven different samples of other importations were, within the space of a month, sent to Dr. Ure for examination, and one and all proved to be of the like spurious description. One from Havre was composed of 95 *per cent. of alcohol*, of specific gravity 0·842 at 60° Fahr., or about 53·7 over-proof. And eight others consisted *entirely of strong alcohol*, disguised only with a very small portion of the *dead* coal oil of the gas manufactories.

From these facts it is easy to judge how much the revenue must have suffered in past years from such sophistications, and how much more it would have suffered in future years, but for the detective investigations of Dr. Ure. Since alcohol is untaxed in America, France, Belgium, and Germany, it can be made in those countries, of a strength much above our proof strength, for less than two shillings a gallon; while here the selling price, duty paid, is from 12 to 15 shillings. No wonder we have a declining revenue, and an income tax to make up the deficiency.

But the injury to the revenue is probably the least serious part of the affair. The British growers, home and colonial, of the vegetable productions from which alcohol is extracted—the British distillers of the alcohol, in all its varieties—the British compounders and rectifiers of spirits—are all deeply injured by this inundation, from foreign parts, of duty free, or next to duty free, alcohol. The "rectifiers in London," Dr. Ure tells us, "who were wont to supply the hat-manufacturers, varnish-makers, and others, with large quantities of spirits of wine weekly, have for some time past sold little or none." "Their occupation 's gone," adds the Doctor. We trust not. The Commissioners of Customs have but to persevere resolutely, for a few months, in confiscating every spurious lot of wood spirit which makes its appearance, (the means of detection are now easy,) and the home manufacture would speedily revive and flourish.

INSTITUTION OF CIVIL ENGINEERS.
MINUTES OF PROCEEDINGS—SESSION 1843.

February 14.

"*Description of Mr. Clay's new Process for making Wrought Iron direct from the Ore; as practised at the Shirva Works, Kirkintilloch, Scotland.*" *By William Neale Clay.*

In this communication, the author first describes the various stages through which the metal passes, between the reduction of the ore and its arriving at the state of malleable iron, by the ordinary mode of manufacture; and then he explains the process which he has invented, and introduced practically at the Shirva Works.

By the ordinary system of iron-making, the ores are reduced into the state of carburet of iron, and then, by refining and puddling, the metal is de-carburetted, thus making it into malleable iron by a number of processes, which are recapitulated:—

1st, Calcining the ore.

2nd, Smelting in a furnace, by the aid of blast, either cold or heated, with raw coal, or coke, for fuel, and limestone as a flux.

3rd, Refining the "pig" into "plate" iron.

4th, Puddling, shingling, and rolling, to produce the "rough," "puddled," or No. 1 bars.

5th, Cutting up, piling, and rolling, to produce "merchant," or No. 2 bars.

6th, A repetition of the same process, to make "best," or No. 3 bars.

Seeking to diminish the number of manipulations, by the new process a mixture of dry Ulverstone, or other rich iron-ore (hæmatite), is ground with about four-tenths of its weight of small coal, so as to pass through a screen of one-eighth of an inch mesh. This mixture is placed in a hopper, fixed over a preparatory bed, or oven, attached to a puddling furnace of the ordinary form. While one charge is being worked and balled, another gradually falls from the hopper, through the crown, upon the preparatory bed, and becomes thoroughly and uniformly heated; the carburetted hydrogen and carbon of the coal, combining with the oxygen of the ore, advances the decomposition of the mineral, while, by the combustion of these gases, the puddling furnace is prevented from being injuriously cooled.

One charge being withdrawn, another is brought forward, and in about an hour and a-half the iron is balled, and ready for shingling and rolling.

The cinder produced, is superior in quality to that which results from the common system; it contains from 50 to 55 per cent. of iron, and is free from phosphoric acid, which frequently exists, and is so injurious, in all the ordinary slags; when re-smelted, it produces as much No. 1 and No. 2 cast-iron, and of as good quality, as the ordinary "black band" ore of Scotland. The cast-iron produced from the slag (amounting to one-third of what was originally contained in the ore) is mixed with the ore and coal in the puddling furnace; and thus, while nearly all the iron is extracted from the ore, as much wrought-iron is produced in a given time, and the same cost of fuel, as by the old system.

The first process, producing puddled bars of superior quality, is consequently on a par with the fourth stage of the old system, as it avoids the necessity of the preceding separate manipulations.

From the absence of all deleterious mixture, by once piling and reheating the rough bars, iron is produced, of a quality, in every respect equal, and in powers of tension superior, to that which results from the second piling and reheating in the common mode; it is therefore contended that the two processes produce from the hæmatite nearly one-third more iron, of as good a quality as is usually obtained by the six processes of the old system.

The iron thus produced bears a high polish, is very uniform in its texture, is ductile and fibrous, having more than an average amount of tensile strength, and at the same time appears to be more dense, as it possesses a peculiar sonorousness, resembling that of a bar of steel when struck. It has also been converted into steel of a good quality.

The paper is illustrated by a drawing of the furnace necessary for the process, and by specimens of the iron and steel produced.

Mr. Clay contended that the ordinary method of making iron was neither so scientific, nor so practically good as there was reason to expect it would have been, when iron formed so considerable an item in the productive industry of the country. His invention was in some degree based upon the old Catalan fire, wherein malleable iron was produced direct from the ore, although by a considerable expenditure of fuel: by his process the ore was also reduced at one operation into the state of malleable iron, by combination with a large portion of carbonaceous matter; and as the deoxydation of the ore could proceed simultaneously in an adjoining preparatory bed, through which the flame of the puddling furnace traversed, there was necessarily a great saving of time, labour, and fuel in the production of the metal, while the quality was at the same time improved. He argued therefore, that if the system was generally adopted, a large portion of the capital now sunk in the expensive constructions of blast furnaces, blowing engines, &c., would be dispensed with.

Mr. Taylor observed, that the process appeared to be only applicable to the rich qualities of iron ore, which were now used in comparatively small quantities, as a mixture with the clay ironstones of the coal fields, from which iron was generally produced in this country. There existed large quantities of hæmatite in Great Britain, equal in quality to that of Nassau, or of the Hartz mountains, from which so much iron was made, for converting into steel. The mines of Ulverstone alone now produce 50,000 tons annually, and at least 25,000 tons more could be shipped from Cornwall; and if a demand existed, there was scarcely a limit to the quantity that could be raised. He apprehended that the iron made by this process could be converted into good steel: this was very desirable, as it would render this country independent of Sweden and Russia, whence nearly all the steel-iron was now imported.

Mr. Heath had examined Mr. Clay's process of iron-making, and found that the wrought iron produced from a mixture of Scottish pig-iron and hæmatite ore, was of a superior quality, bearing severe tests without injury. The iron made by this method, from Indian pig-iron and spicular iron ore (per-oxyde of iron), from Devonshire, which was identical in quality with the celebrated Elba ore, when converted into cast steel, by a process which he had accidentally discovered, possessed the quality of welding like shear steel, without any of its defects. The method he alluded to, was to combine manganese with the cast steel in the crucible, and when out under the tilt hammer it could be worked and welded to iron, like shear steel: the consequence of this discovery was, that the latter quality of steel was almost abandoned for cutlery, and the former was now generally used, as it did not exhibit the laminated appearance when polished, which shear steel frequently did. The metal was sounder, and fewer wasters were made. All the brown hæmatites contained manganese, and there was little doubt that, by selecting the proper kinds of ore, malleable iron might be made in Great Britain by this process, as good for converting into steel as any of the

Swedish iron. There was abundance of spicular iron ore on Dartmoor, equal to the Elba ore, and which would (he had little doubt) produce as good iron as that from the Dannemora ore.

Dr. Faraday remarked, that the process invented by Mr. Clay was founded on sound chemical principles. It was desirable to abandon the use of limestone as a flux: it was proved that the purest limestones contained phosphates, which, although advantageous in agricultural processes, were detrimental in iron making.

Mr. Fox had tried some specimens of Mr. Clay's iron, and found them to bear severe tests, as well as the best cable bolt iron made in the ordinary manner.

Mr. Clay explained that Mr. Heath's process was not indispensable, for converting into steel the iron made by his method; and also that argillaceous iron ores, after calcination, could be treated in his furnace, like the hæmatite ores, but not so advantageously.

Mr. Taylor said that 25,000 tons of steel were converted annually in this country, and of that quantity not more than 2,500 tons were made from the best Swedish iron; for the remainder, inferior qualities of iron, such as Russian iron, marked CCND, from the forges of Monsieur Demidoff, were used. All that iron was made with charcoal, and could only be called inferior when compared with that made from the Dannemora ore. If Mr. Clay's process was successful in treating the hæmatite ores, as had been stated, it was of great importance, as it would emancipate the country from a dependance upon foreign products.

He had recently seen in Germany a process of producing steel by stopping the operation of puddling pig iron at a certain point, or intermediate state between cast and wrought-iron, and hammering the mass at once into bars. The operation was one of much delicacy, and depended entirely upon the skill of the workman.

Mr. Heath believed the manufacture of steel was involved in unnecessary mystery; it was the general opinion that foreign iron was essential to produce good qualities. Iron as now made from coke furnaces certainly contained too much foreign matter to be used for steel, and it would require more attention to the selection of the materials, before pure iron could be obtained; some of the Low Moor iron, the good quality of which was universally admitted, had been made into blistered steel, but although the springs made with it appeared perfect, it was said that they did not answer so well as those made with steel from charcoal iron.

The Sheffield manufacturers required that steel should possess "nature and body;" the first quality to enable it to be rolled and drawn out without cracking, and the second that it might receive and retain a fine edge. Steel made from Garnderris iron (South Wales) possessed "nature," but if made into cast-steel it fled into pieces on working, as it did not possess "body." Steel from German ores appeared to have "body," but wanted "nature." Steel from Indian iron, although difficult to work, stood better than other kinds when once reduced into form; this he attributed to the purity of the magnetic ore from which it was produced; there was not the slightest trace of phosphorus, arsenic, or any deleterious foreign matter. He was convinced that, with a mixture of Indian pig-iron (which could be produced very cheaply) and Devonshire ore, by Mr. Clay's process, iron could be made of excellent quality for converting into steel at such a reduced price as would render the introduction of Swedish and other foreign iron unnecessary.

Mr. Taylor believed that improvement in the quality of steel, rather than reduction in the price was the object to be sought. In the large quantity used in the mines under his direction, the dearest steel was found to be the most economical. He had seen as many as twelve dozen borers used to make one blast-hole, and unless the tools kept their points well, the labour of the men was thrown away.

February 21, 1843.

"*Account of a series of experiments on the comparative strength of solid and hollow Axles.*" *By John Oliver York. Assoc. Inst. C.E.**

The author first describes the causes of fracture in railway axles, which he attributes to the sudden strains and injury produced by concussion and vibration. Those resulting from concussion are chiefly ascribed to a defective state of the permanent way, any sudden obstacle opposing itself to the progress of the train, and the severe shocks arising from the wheels coming in contact with the blocks and sleepers when thrown off the line. The force of vibration and its certain effect to produce fracture in a body so rigid as a railway axle, is then fully explained; the evil arises from the impossibility of diverting from the axle the continued series of slight blows or vibrations to which it is subject, or of causing a free circulation of them through its entire length, since the naves of the wheels being fixed tightly on to the axles, form a point on either side for the vibrations to

* For abstract of Mr. York's patent for axles, see our last Number.—Ed. M. M.

cease, and the particles of iron composing the axle at this point become dislocated by the continued and unequal strain, and ultimately break; the same action is described as taking place in the journal of the axle, and hence the fact that an axle seldom breaks excepting at the journal, or at the back of the nave of the wheel. The twisting strain to which railway axles are subject is next considered, and a calculation entered into, to prove that upon a circle of only a few feet in diameter, and assuming a first-class carriage on four wheels to weigh 6 tons, the strain resulting from this cause is so slight as to be unworthy of consideration in the inquiry. The paper next proceeds to point out, how and why the hollow axle is better able to resist the strains before referred to, than the solid ones now in use.

First, by the process of manufacture, by which the crystallization of the iron is avoided, and it is left in a better state for sustaining sudden strains and continued action. Secondly, by the position of the metal composing the axle, since the comparative strength of axles, are as the cubes of their diameters, and their comparative weights, only as their squares, consequently, with less weight there must be increased strength; and thirdly, that the vibration has a free circulation through the length of the axle, no part being subject to an unequal shock from the vibration, and the axle would therefore receive much less injury from this cause. In conclusion, it is submitted that a railway axle should possess the greatest possible degree of rigidity between the wheels, to prevent it from bending or breaking from concussion, combined with the greatest amount of elasticity and freedom in the particles of iron within the axle itself, to prevent the injurious effects of vibration.

The details of a numerous set of experiments are then given, to prove the superiority of the hollow axle in all these respects, the average of the whole of which is thus stated.

As regards rigidity to sustain a dead weight.

The axles being supported at the ends, and the weights applied in the middle.

Hollow Axle.						Solid Axle.			
Weight.				Deflection.	Permanent Set.	Weight.		Deflection.	Permanent Set.
Tons.	Cwt.	Qrs.	Lbs.	Inch.	Inch.	Tons.	Cwt.	Inch.	Inch.
7	14	..	6	$\frac{1}{16}$	..	7	14	$\frac{5}{16}$	$\frac{1}{16}$
9	2	..	..	$\frac{3}{16}$	..	8	1	$\frac{3}{8}$	$\frac{5}{32}$
9	16	..	..	$\frac{3}{8}$	$\frac{1}{8}$				

As regards its capability to resist a falling weight.

5 cwt. 3 qrs. 6 lbs. falling from a height of 16 feet on to the centre of the axle.

Hollow Axle.		Solid Axle.	
1st blow, deflection	$1\frac{1}{8}$	1st blow, deflection	$1\frac{3}{4}$
2nd ,, ,,	$2\frac{1}{4}$	2nd ,, ,,	$3\frac{1}{4}$
3rd ,, ,,	$3\frac{1}{4}$	3rd ,, ,,	$4\frac{1}{4}$

As regards the elasticity and fibrous quality of the journals.

Hollow Axle.		Solid Axle.	
Number of blows to destroy journal (average)	28	Number of blows to destroy journal (average	10

Proportions of axles.

	Hollow Axles.	Solid Axles.
Diameter	4 inches	$3\frac{1}{2}$ inches.
Weight	1 cwt. 2 qrs. 20 lbs.	1 cwt. 3 qrs. 24 lbs.

The paper is illustrated by specimens of the broken axles, both hollow and solid, and by diagrams of the mode of manufacturing the two kinds of axles.

Mr. Geach presented a series of specimens of ends broken off solid axles, made by the Patent Shaft and Axle Company, Wednesbury; they had borne severally 886, 148, 293, and 278 blows of a sledge-hammer, weighing 38 lbs. before they separated from he body; above twenty more ends had been

broken off, the weakest requiring 138 blows. The diameter of these journals was 2½ inches.

An axle was exhibited which had been nearly doubled under an hydraulic press, with a pressure of 64 tons: the journals (2¼ inches diameter) were also bent in opposite directions, by repeated blows of a sledge hammer, without any signs of fracture being perceptible.

The firm which Mr. Geach represented, had made upwards of twenty-five thousand axles, and had tried a very large number by breaking them; they almost uniformly found them of good quality, which might be attributed to the mode of manufacture. Around a centre bar of iron were placed eight bars rolled to a proper form to complete a circle, the joints radiating from the centre; they were then welded together by rolling, and finished under the hammer; the fibre of the iron, it was contended, was thus worked, and remained in its most favourable position.

He was not opposed to the principle of hollow axles, but he wished to prevent any unnecessary prejudice against solid ones by inferences from any one set of experiments: he would therefore suggest that another series of experiments should be made between the relative strength of the two kinds of axles, for which he would contribute the necessary number of solid ones.

Mr. York described the manner in which the solid axles had been selected for the purpose of experiment. Having obtained General Pasley's consent to be present on the occasion, he ordered axles from the Patent Axle Company, and another eminent maker, and selected also several other axles supplied by the Patent Axle Company to the London and Birmingham Railway; these axles were new, never having been under any carriage; he contended that the result of the experiments afforded a fair specimen of the axles generally in use, and were such as the public were in the habit of riding upon. The axles which had since been made by the Axle Company, and were then exhibited to the meeting, showed a quality of iron which could not be surpassed: if this was the usual quality made use of by that company, it still more forcibly proved his position as to the uncertainty of manufacturing solid axles, for while one specimen took a great number of blows to break it, the majority of them were fractured by a slight force; it was this uncertainty which he proposed to avoid, and he contended that it was inseparable from the method of making axles described by Mr. Geach, for in passing the faggot through the rolls to weld the bars together, it frequently happened that they were only united to a depth of one-half or three-quarters of an inch, hence it was to a certain extent hollow, and partially avoided the injurious effect of hammering; if, on the contrary, they were perfectly welded, the iron became crystallized, as in any other solid axle: this fact was proved by the specimens before the meeting, those that were solid having been broken by very little force, and the unsound ones requiring a great number of blows to produce fracture.

In the experiments, the hollow axles had broken under a different number of blows, but this was owing to their having been made of larger diameter in the journals than the solid ones (but with only an equal quantity of metal in them), and afterwards turned down to the same diameter, which left them of unequal thickness and too thin for a fair test; still, however, with less metal than in the solid ones, they were stronger; this might be accounted for by the mode of manufacture, as by retaining the axle hollow the crystallization of the iron was avoided.

The present mode of making the hollow axle he described to be by taking two trough-shaped semicircular pieces of iron, bringing their edges together, and welding them under a hammer between swages. He however dissented from the process of hammering, and intended to finish his hollow axles by compression only. This, he contended, would avoid the injury done to the iron by the present mode of manufacture, and that with the same quantity of iron, the strength of axles being as the cubes of their diameters, and their weights only as the squares, a hollow axle must possess considerable advantage over a solid one.

Hollow axles had long been considered desirable, but the expense of making them had hitherto prevented their use; he had reduced their cost by his process to the same rate as the solid ones, and felt confident that in bringing them under the consideration of the profession, through the Institution, they would be fairly treated and ultimately adopted.

General Pasley confirmed the correctness of the results recorded by Mr. York, and the satisfactory nature of the experiments, which had impressed him with a favourable opinion towards hollow axles. It was of importance to avoid deflection, as it was almost as fatal as fracture in causing accidents. After the late accident on the North Midland Railway, he observed a solid axle bent into the form of the letter C, and the upper portions of the periphery of the wheels nearly touching each other. The hollow axles would certainly resist deflection better than solid ones of corresponding weight. In answer to a question, Mr. York said that the iron was chiefly injured by the amount of hammering which it received in forging.

Mr. Taylor remarked, that the question of the amount of injury received by iron in working was discussed at the meeting of the British Association, in 1842, and the effects of vibration and electricity had also been treated of by foreign engineers. It appeared to be generally admitted, that the great source of mischief was the cold swageing which the iron received, in order to give the work a good appearance. In order to test this, Mr. Nasmyth subjected the two pieces of cable bolt iron to 160 blows between swages, and afterwards annealed one of the pieces for a few hours. The unannealed piece broke with five or six blows of a hammer, showing a crystallized fracture; while the annealed piece was bent double under a great number of blows, and exhibited a fine fibrous texture. The fact of the fibre being restored by annealing was well understood and practised by smiths, particularly in chain-making.

Mr. York could not entirely subscribe to the great benefit of annealing, as he had found that, after annealing one end of a hollow axle for 48 hours, it was broken off by 82 blows, while the other (unannealed) end of the same axle resisted as far as 78 blows.

In answer to a question from Alderman Thompson, Mr. York said that he had found as much mischief arise from over-heating iron as from over-hammering it; but the difference of the appearance of the fracture indicated immediately when iron had been burned.

Mr. Taylor said that, in Mr. Nasmyth's experiments, the over-heated iron was almost as fragile as glass.

Mr. Gravatt believed that vibration, whether caused by the smith in working the iron, or by the use to which the bar was appropriated, was the reason of its fracture, and it was certain that a constant change was going on in all manufactured iron. At the Thames Tunnel the "fleeting bars" used as levers for turning the large screws for forcing forward the shield, never lasted longer than three or four weeks, although they were very strong, and were made from the best materials, by careful smiths. They were only used occasionally, and then without any concussion, having only the power of eight men exerted upon them: yet they broke constantly, and the fracture exhibited a bright crystallized appearance. It was found at last, that in order to give them duration they should be left rough, and not hammered much in working.

Mr. Newton observed that full ten years since, Dr. Church had used hollow axles for his experimental steam coach on common roads, being convinced of their superiority.

Mr. Fox was an advocate for the hollow axles, but he did not consider the present experiments quite conclusive, as there were differences in the relative dimensions of the axles experimented upon; he would suggest another series of trials, upon a larger number of axles, as the subject was one of great importance, not only to manufacturers but to the public, whose safety in travelling depended upon the goodness of the axles under the carriages. He had used upwards of 5000 axles made by the Patent Axle Company, and had made many experiments by breaking them; the average result was equal to that quoted by Mr. York. He agreed in the danger arising from overheating iron, as also from over-hammering it, and for some time past he had caused all the axles to be made 6 inches longer than was necessary, in order to cut 3 inches off each end, to try the quality and the appearance of the fracture of the iron.

The President remarked, that there could not exist a doubt as to the greater strength of a hollow axle, as compared with a solid one; both containing the same weight of material; the principal question to be considered was, that of vibration, and its effect upon the cohesive strength of the metal; whether the action upon the particles was more irregular in the solid body, and more distributed in the hollow one; he recommended this investigation to some of the mathematicians who were present; the result of their inquiries might materially aid in the development of truth from the practical experiments.

CONCUSSION SHELLS AND FIELD ARTILLERY.

Captain Norton has made application to the Master General and Board of Ordnance, to be permitted to adapt his concussion shell to field artillery, believing that such shells may be used with good effect against an enemy posted in block-houses, farm-houses, mills, &c., &c. These shells have been already tested from the eight and ten-inch guns, otherwise called the 68 and 130 pounders, and the Select Committee of artillery officers, at Woolwich, in their Official Report to the Master General, dated 15th October, 1842, have pronounced them "simple, safe, and efficacious."

MR. PILBROW'S "DISCOVERY."

Sir,—I have read with much attention the various discussions on this most interesting question, and regret that the author of the invention, or Scalpel, (who seems to know as much about it,) has not favoured us with further particulars, for none are so competent to speak of a new science as those who have seen the experiments. That Mr. Pil-

brow has made a great discovery in ascertaining the *proper force* of the emission of steam, no doubt can exist, since never before have I seen in any work so great an effect stated to have been produced. But if it be, as stated by Mr. Cheverton, (who has so ably discussed the subject,) that this double force is obtained only by three or four times the consumption of steam, of what use is the discovery? Every invention must at last come to the standard of commercial value, and as every thing in this country is regulated by *£ s. d.*, unless Mr Pilbrow can satisfy us on this material point, it is quite useless for him to waste any more time about it. I trust he will excuse this open expression of my sentiments for the sake of their good meaning.

Will Mr. Cheverton favour us with an explanation of the initial and expansive velocities of steam? These terms I cannot find in any work, but in the *Mechanics' Magazine*, (see Scalpel's letter,) and as Mr. Cheverton has made his calculations of the effect, (force and velocity,) will he oblige us further by giving us the rule to calculate the velocity of steam at different pressures?

I remain, Sir, your obedient servant,

"INVENTOR."

MECHANICAL VENTILATION OF COAL MINES.

[From the *Gateshead Observer*.]

Sir,—Noticing the particulars of an inquest held on the bodies of twenty-seven unfortunate individuals who lost their lives from an explosion of "fire-damp" at Stormont Main Colliery, near Newcastle, I am induced to make a few remarks on the causes of these too frequent occurrences, and how they may be prevented from taking place in future. In the first place, a furnace at the bottom of the shaft is not a sufficiently powerful agent for ventilation; and, secondly, if it were so, is not always to be depended upon. A furnace consuming 18 cwts. of Newcastle undressed small coal in twenty-four hours the barometer at 29·5, the temperature of the mine 60° Fahrenheit, and the wind blowing from the most favourable point of the compass, will cause 212 cubic yards and one-tenth of atmospheric air to pass through the mines per minute. This quantity is not above half sufficient to keep the workings in a safe, healthy, and well-ventilated state.* It might answer in ordinary cases, but not for contingent purposes, such as fall from the roof, lifting of the bottom, coming in contact with blowers, or any other accidental occurrence, which may cause a larger supply of inflammable air than is usual. I here venture to lay before you the nature and properties of "fire-damp," its exact effect after combustion, &c., which will clearly show that the quantity of air travelling through the mine is quite inadequate for the proper and safe working thereof.

"*Bihyduret of Carbon, or Light-Carburetted Hydrogen.*—Equivalent by weight 8 (carbon 6 *plus* 2 hydrogen); specific gravity, 0·555. Bihyduret of carbon cannot support combustion, or respiration, and is absorbed very sparingly by water. It burns with a yellow flame, and consumes twice its volume of oxygen during its combustion, the two equivalents of hydrogen which it contains in a condensed state, combining with two equivalents of oxygen, and forming two of water, while the carbon unites with as much more, and is converted into carbonic acid. The pure bihyduret does not detonate, unless mixed with more than four times its volume of atmospheric air; and the explosion is feeble, till seven or eight times its bulk is added. With more than fourteen times its volume of air, it does not form an explosive mixture, a candle merely burning in it with an enlarged flame."—*Dr. D. B. Reid's Chemistry.*

From these remarks you will readily perceive what an immense space in the mine will be surcharged with the after damp. Now, Sir, it appears evident, that in certain cases there is only a sufficient quantity of air to dilute the carburetted hydrogen to the most explosive point possible—that is, seven or eight volumes of atmospheric air to one of gas. But to reduce this inflammable air below the explosive point, it requires double the quantity of air now used—which cannot be effected, nor is it practicable, from the use of furnaces, for it would require a furnace, or furnaces, which would consume 72 cwts. of coal of the same quality as above named. The immense heat which would arise from such extensive fires, would set fire to the pit sides, render the upcast shaft impassable, and destroy every thing that came in contact with it. The only course that can be taken, is the application of mechanical force—which will answer the desired purpose, and at a much cheaper rate than using a furnace. The following description of an apparatus, and mode of fixing it, will, I have no doubt, be acceptable. I construct a rotary air drum, similar to a

* These calculations are extracted from a table I am forming on the velocity of wind passing through mines, according to the quantity of fuel consumed in twenty-four hours, commencing with an area of wind road 1 ft. 6 in. by 3 ft., and terminating at 8 ft. by 6 ft. 6 in., and will contain 8320 velocities. This is for ascertaining whether the furnace is working up to its duty or not. The table begins with 1 cwt. per twenty-four hours, advancing by 1 cwt., and ends at 80.

barrel churn, with outlets for air at the circumference, and an inlet on each side at the centre. To each of these centre holes is attached a pipe four feet long, and placed over a "staple pit" sunk four or five yards deep, and communicating at any convenient depth from the top of the pit, where a "close scaffold" can be introduced immediately below the straps, and bolt heads of the pumping engine spear-rods. The engine-pit is made the upcast shaft for bad air, and, of course, the bye-pit shaft the downcast for good air. When properly constructed and set in motion, this machine will exhaust 500 cubic yards of air per minute, at a cost of only 1*s*. or 1*s*. 6*d*. per twenty-four hours. It requires a 3-horse engine to work it, which is supplied with steam from the boiler of the pumping engine; and as there is frequently a large quantity of surplus steam blowing off, this small engine may, to a very great extent, be worked with it, and a very little extra firing will make up the deficiency. There are several of these machines now at work in various parts of the country; and I have assurances from men working in those collieries, that they never experienced such a well-regulated ventilation before, and not any "fire damp" to be found; but previous to the application of this apparatus, the pits were not workable. I have a number of testimonials from practical men, who have been in pits that I have applied it to. I am surprised that a coaling district like Northumberland and Durham has not introduced it long ago—allowing the coalmasters in Staffordshire, Lancashire, and Yorkshire, to be before them in finding out the use and value of such an efficient, humane, and philanthropic invention.

When the machine is at rest, the ventilation goes on at a rapid rate, on account of the rarefaction of the engine pit, being warmed from the heat of the mine, and the temperature of the working barrels of the pumps. I am surprised the Committee on Accidents in Mines, and who hold their sittings at Shields, do not raise as much money as will furnish one, and satisfy themselves on the subject. I should say 60*l*. or 70*l*. would be quite sufficient to try it, and about as much more to make it permanent. This would set aside all the prejudices that exist against mechanical force being a suitable plan for ventilating mines. Newcastle standard pit candles, which count as far as forty-five in the pound, would have to be reduced to fourteen or sixteen in the pound, otherwise they would not keep lit. I dare say forty-five in the pound will produce as large a flame as is consistent with the safety of the mine; but where there is no "fire-damp" to combat with, or at least never to reach the firing point but at "blowers," it is not of any moment what sort of flame, either large or small, or what the combustible body is composed of.

W. Fourness.

St. James's-place, Leeds, April 29.

AURORA BOREALIS.

Collingwood, May 7.

Last night (Saturday, May 6) having been remarkable for one of the most brilliant displays of aurora borealis which it has ever been my good fortune to witness, it occurs to me that a notice of the principal phases of the phenomenon, as observed from this place, may not be unacceptable to your meteorological readers. The day had been overcast and showery, and between 5 and 6 P.M. a heavy fall of rain took place, after which the sky cleared gradually, and at length became perfectly serene and cloudless, a calm, or very gentle air from the westward prevailing. It was at 10 P.M., or a few minutes after, that, looking out towards the south, my attention was attracted by a small luminous patch, unlike an ordinary moon lighted cloud, in the constellation Leo, and going out where an uninterrupted view of the north horizon could be obtained, a pretty strong auroral glow was observed, in spite of the bright moonlight. But what chiefly attracted my attention was a large and exceedingly luminous white nebulous mass, in form something like an inverted comma, occupying a space from about the altitude of α Cassiopeiæ (which its eastern border nearly touched), to the Pole Star. At a cursory glance it might have been taken for a cloud, but that its light was much stronger than any cloud simply illuminated by a moon in the first quarter could have emitted. It differed also from any ordinary cloud, in the exceeding softness of graduation of its light and the regularity of its condensation towards the middle, but, above all, in the continual changes it underwent of general form, size, and brightness, without perceptibly shifting its place, (at least, in a short time, though, on the whole, it kept slowly ascending). At 10 h. 15 m. this mass had almost completely disappeared, being reduced to a faint streak of light traversing the interval, from α Cassiopeiæ to η Ursæ Majoris, but its disappearance was only temporary, as at 10 h. 17 m. it re-appeared in the form of two large nebular and rounded patches of unequal size, running together, and occupying the middle of the interval above-mentioned, the streak still subsisting. At the same time a faint horizontal streak began to be observed below the moon and the stars Castor and Pollux. At 10 h. 18 m. the southward progress of the nebulous mass was very evident, as it now occupied the region about the head of Draco and legs

of Hercules, being very bright and large. In another minute, however (10 h. 19 m.), it had again entirely disappeared: meanwhile, the streak or streamer above alluded to still subsisted (10 h. 20 m.), proceeding apparently from a most vivid glare in the north horizon, under Cassiopeiæ. At 10 h. 22 m. the nebulous mass again appeared under Lyra, near Cerberus, to the east, having, therefore, drifted, on the whole, and supposing it to have been the same mass in its successive appearances and disappearances, nearly along the course of a parallel to the solstitial colure in the then position of the starry hemisphere. At this time faint streamers were rising from the northern auroral glare. 10 h. 23 m., a faint nebular mass is now formed near the moon, and touching on α Hydræ, which, for distinction's sake, we shall call B, denoting that where movements have been hitherto followed by A, another (C) is forming near β Leonis.

10 h. 25 m. A is now exceedingly bright, round, and well insulated; C is faint, as is also B; and there seems a tendency, by the connexion of the two latter, to form an arch. A very brilliant streamer now issues from the northern glow, of a reddish hue, the nebulous masses remaining purely white.

An interruption now took place in the observations, while looking over the maps and charts. At 10 h. 37 m. resumed: the streamers were now of exceeding brilliancy, At 10 h. 38 m. another nebulous mass, D. had formed on Corona Borealis. It enlarged rapidly towards the south, and at 10 h. 40 m. had become a great two-lobed cloud of white and very intense light. Meanwhile the northern glare went on increasing, darting forth superb reddish streamers, some of which nearly reached the zenith. At 10 h. 43 m. the nebulous mass A has shifted still more to the south, being now near α Ophiuchi, and appears to be dilating westwards, as if tending to form an arch by union with the other masses. About this time the furnace glow in the north horizon, which had long been acquiring intensity, began to grow tremendous, and for the next ten minutes had all the appearance of an immense conflagration. Broad and vivid streamers burst forth from a ragged and broken central black mass, not all from one edge, but as if emitted from various depths within its substance; several were extremely concentrated and luminous; others diffuse, and of a very evident crimson colour. No undulatory movements were, however, observed, or pulsations of light. The crimson colour above alluded to was not confined to the visible lines of streamers, but was diffused over a very large space in the north-east quarter of the heavens.

10 h. 55 m. After an interval of extinction of the nebulous mass B bursts forth again of great intensity half way between α α Hydræ and Corvus. A is also bright, and now stands a little to the south of β Ophiuchi, having drifted southwards.

10 h. 58 m. B and D are vanished. A extends from ζ Serpentis, westwards, in an oval form. The northern streamers are grown faint, but there is now formed an *upper* line, or low arch of broken auroral glare. From this period the intensity of all the phenomena rapidly relaxed. At 11 h. 0 m. a patch of irregular figure, with descending oblique dashes of light, was formed over the moon, which faded in a couple of minutes, and was speedily succeeded (at 11 h. 4 m.) by a luminous appearance, having the aspect of a mixture of auroral gleam and actual cloud, over Castor, Pollux, and the moon, involving the latter.

11 h. 7 m. All grown fainter. The nebulous mass A alone remains, and very faint: it occupies, as an ill-defined oval, the middle of the triangle formed by β, μ, and ζ Ophiuchi. The northern glow is faint and breaking up.

11 h. 11 m. All the nebulous masses have vanished, except one Camelopardalus, which may be cloud, but there is yet a glow in the north horizon (11 h. 20 m.), in a low, regular, and concentrated arch, whose crown is in the magnetic meridian, and whose eastern portion is much the brightest.

11 h. 22 m. After a long pause a streamer breaks forth, somewhat west of Capella, from what is *now* the brightest part of the glow. From this time the auroral phenomena, with exception of a low glow, and very faint occasional streamer, disappeared. But at 11 h. 33 m. a formation of hazy clouds took place in the region occupied by the moon, accompanied by what might be regarded as auroral streaks perpendicular to the magnetic meridian. I had always hitherto doubted of the often-alleged connexion of aurora with cloud streaks, but on this occasion I felt disposed to consider that connexion as real. Certain it is, that from the constellation Crater, through β and δ Leonis, up to β and α Ursæ Majoris, a luminous streak extended, which, in one part of its extent, was undoubtedly moon-lighted cloud, in others *hardly* doubtful aurora. The prolongation of this arc beyond α Ursæ also encountered another small cloud, which seemed to resolve itself into auroral nebulosity, and at last disappeared. But as at length the haze assumed a decided *watery* appearance, and actually dimmed the moon, I will not venture to speak decidedly on this point. I am, &c., J. F. W. HERSCHEL.

Athenæum.

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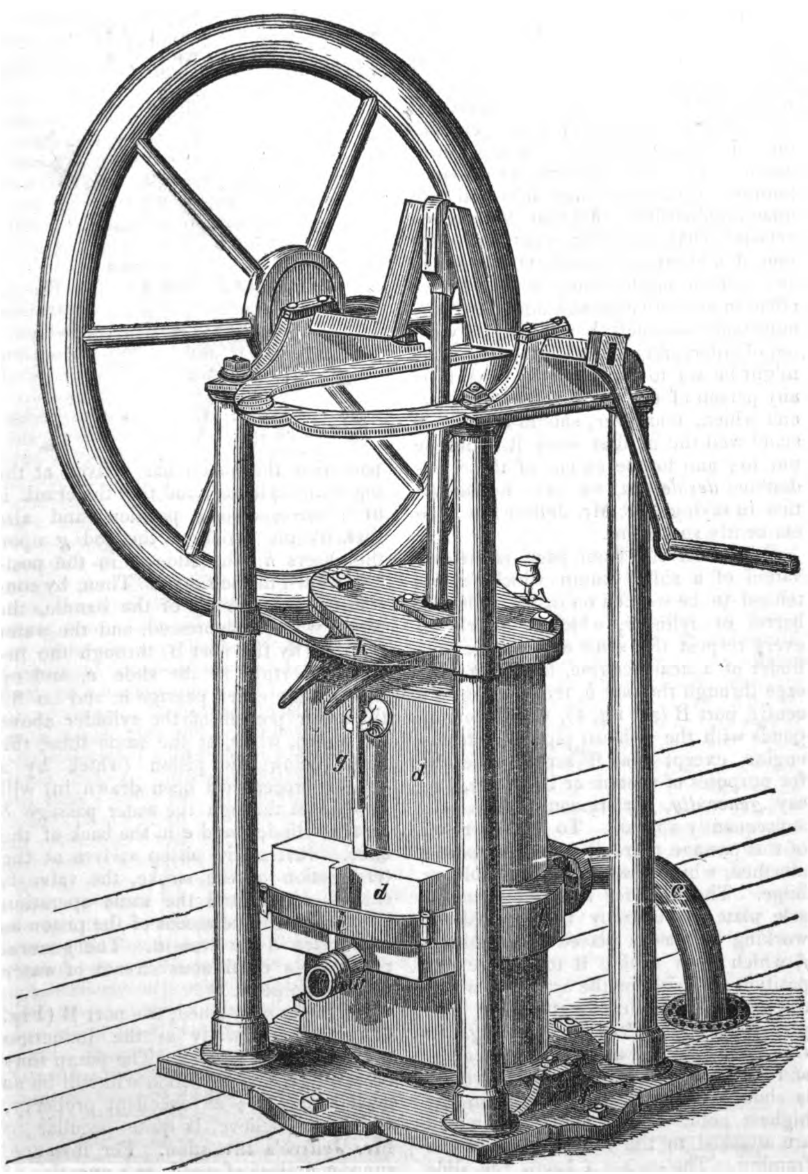
JEFFREE'S SHIP PUMP.

Fig. 1.

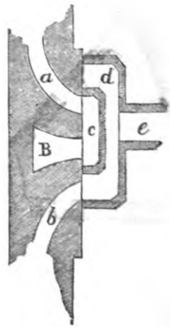


JEFFREE'S PATENT PUMP.

We gave some time ago a description of this invention drawn up from the materials furnished by the specification of the patentee; but having since had an opportunity of inspecting several pumps which Mr. Jeffree has made for actual use, we feel that something more is wanting at our hands to make our readers fully acquainted with the advantages which belong to his plan of construction. Surpassing power is not claimed for this pump; and still less the power boasted of by the proprietors of some pumps, of accomplishing lifts that are unaccomplishable. All that Mr. Jeffree appears to have aimed at, was the production of a cheap and simple pump, which any person might work with average effect in any situation and under any circumstances—which should not easily get out of order, and when out of order, which might be set to rights in an instant by any person of the commonest capacity—and which, moreover, should be able to stand well the hardest work it could be put to; and to the extent of these undoubted *desiderata*, we have no hesitation in saying, that Mr. Jeffree has been eminently successful.

Fig. 1, on our front page, is an elevation of a ship's pump which is intended to be worked on deck; *a* is the barrel or cylinder, which is nearly in every respect the same as the steam cylinder of a steam-engine, having a passage through the belt *b*, terminating in a centre port B (see fig. 4), which corresponds with the exhaust pipe of a steam-engine, except that it serves generally for purposes of suction or induction, (we say *generally*, for reasons which will subsequently appear). To the other end of this passage there is a flexible pipe *c* attached, which passes into the hold or bilge. The cylinder is attached to the sole plate or base by the journals *e*, working in brasses placed on the blocks *f*, which thus enable it to assume any position requisite for the crank, to which the piston-rod is directly attached. The piston has no *valves or openings in it*. The slide *d* is moved by the rod *g*, and the head of this rod, just as the stroke is about to terminate, comes upon the highest point of the sheers *h*, which are attached to the two columns of the framing. The spring *i* keeps the slide valve close upon the face. The object of the fly-wheel is to give uniformity to the motion; but such an addition is not absolutely necessary, as will be seen by referring to fig. 2. To enable the reader to understand clearly the action of the pump, he will please refer to fig. 4, which is a section of the water passages and the slide. Let us sup-

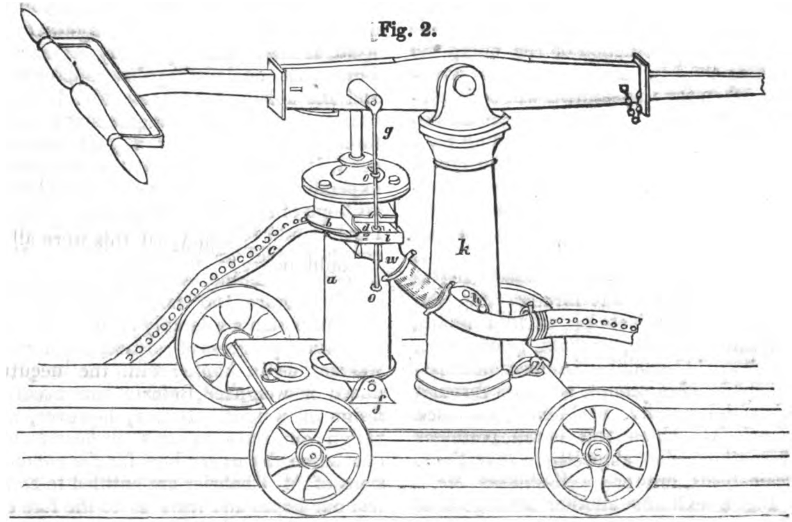
Fig. 4.



pose that the piston has arrived at the top of the cylinder, and that the crank is in a corresponding position, and also that, by the action of the rod *g* upon the sheers *h*, the slide is in the position shown in the figure. Then, by continuing the turning of the handle, the piston will be depressed, and the water rush in by the port B, through the internal aperture in the slide *c*, and up through the water passage *a*, and so fill the upper portion of the cylinder above the piston, while, at the same time, the water below the piston (which by a similar process had been drawn in) will be ejected through the water passage *b* in the cylinder, and *e* in the back of the slide. Just as the piston arrives at the termination of the stroke, the valve is shifted down, and the same operation performed in the ascent of the piston as took place in the descent. The general result is, a continuous stream of water from the pipe *w*.

As before mentioned, the port B (Fig. 4) serves generally as the induction pipe, but not always so. The pump may be reversed, and its action will still be as good as before; an excellent property, which, we believe, is quite peculiar to Mr. Jeffree's invention. For instance, suppose a piece of wood, or a quantity of loose hemp, should get into the passages,

Fig. 2.



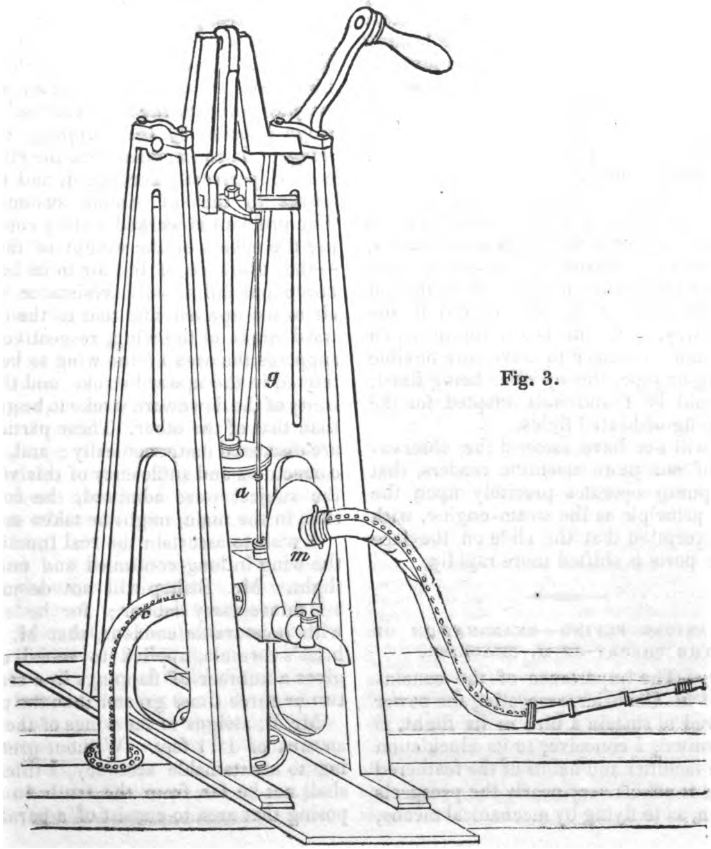


Fig. 3.

and that it is too large to force its way through them, then all that need be done is to reverse the action of the pump, by turning the handle in the opposite direction, when the impediment will be immediately removed. There will be no necessity for this purpose, of sending back the water, or other liquid, for the atmospheric air alone will be sufficiently compressed to force out whatever may have choked up the passages. It is farther particularly worthy of notice that it is only such large pieces of wood, &c., as cannot find their way through the passages that will choke such a pump. Anything smaller, as grain, gravel, &c., which would become an insuperable impediment in other pumps, will pass through this with impunity. And hence, a decided superiority which this pump possesses over others, for shipping, excavations, steam-boats, brewers, well-sinkers, &c.

Fig. 2 exhibits another arrangement of this pump adapted to forcing purposes, as extinction of fires, irrigation, &c.; from the pipe *w* there is a pipe leading into the column upon which the lever is centred, the internal hollow of which constitutes the air-vessel.

Fig. 3 represents a pump similar to the preceding in its principle of action, but firmly secured to the sole plate. The piston rod is furnished with a cross-head, the ends of which work in groves in the framing, which thus act as guides. The slide is moved at the proper time by two small nuts, *o o*, placed on the rod *g*, (the slide of fig. 2 is moved in the same way.) As this is a pump in which it is not necessary to have any flexible tubing or pipe, the cylinder being fixed, it would be found well adapted for the pumping of heated fluids.

It will not have escaped the observation of our more scientific readers, that this pump operates precisely upon the same principle as the steam-engine, with the exception that the slide on the face of the ports is shifted more rapidly.

MECHANICAL FLYING—EXAMINATION OF THE THEORY OF M. CHABRIER.

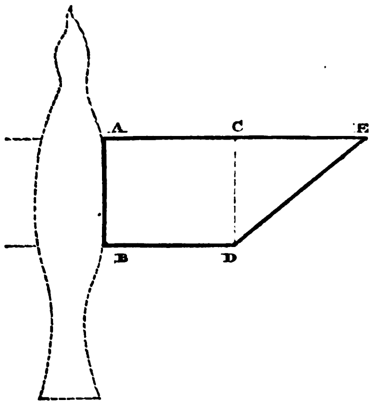
Sir,—The importance of the conclusion of M. Chabrier, respecting the power required to sustain a bird in its flight, is not limited, I conceive, to its elucidation of the faculties and habits of the feathered races; it affects very nearly the prospects of men, as to flying by mechanical means, and, therefore, by no very presumptuous inference, those of their flight *against* the wind, at considerable speed, by any means. For if, as is concluded by that philosopher, and his able commentator Mr. Bishop, the support of a bird requires as great a force as would raise it $27\frac{1}{2}$ feet per second, it is easy to see that the enormous expenditure of power precludes almost all hope of success. By an easy reckoning it would follow, (if this were all that could be said on the subject,) that Mr. Henson's machine, of 3,000 lbs. weight, would require 150 horses' power,—an amount which a tolerably strong faith in the future progress of science, can hardly warrant us in hoping will ever be produced and applied, within the needful limits of weight. Before, however, we resign ourselves to this disheartening conviction, let us see how far the conclusions of M. Chabrier are entitled to control our hopes and fears as to the fate of Mr. Henson's scheme.

The investigation of the French philosopher was designed to ascertain the amount of power to be expended by a bird in sustaining itself in the air, *on the supposition that the sustentation is always effected by the flapping of the wings.* It commences with the stronger case of perpendicular ascent, and thence passes to that of simple sustentation. The problem is worked out by considering the effects of the weight of the bird—the resistance of the air to its body in rising and falling—the resistance of the air to the upward, and that to the downward stroke of the wing, respectively: it supposes the area of the wing to be contracted in the upward stroke, and the velocity of the downward stroke to be greater than that of the other. These particulars are discussed mathematically; and, if the correctness and sufficiency of this view of the subject were admitted, the conclusion, in the main, might be taken as true.

I wish to ascertain the real function of the wing in long-continued and uniform flight. Mr. Bishop will not deem this an unnecessary labour; for he states, with honourable candour, that M. Chabrier's formula, applied to actual cases, gives a number of flappings in a second, two or three times greater than the truth.

Mr. B. assigns to the wings of the rook an area of 1·11 feet. Without pretending to unattainable accuracy, I think we shall not be far from the truth in supposing that area to consist of a parallelo-

gram, A B C D, next to the body of the bird, lengthened by a triangle C D E; and that A C and C E are equal to each other, and, of course, each is half of A E.



If, in such a figure, we take A E and A B, that is, the length and breadth of the wing, at $16\frac{1}{2}$ and $6\frac{1}{2}$ inches respectively, we shall have an area which corresponds with that given by Mr. B., and proportions agreeing very nearly with those of nature. Supposing such a wing to vibrate round the line A B as an axis, its centre of effect will be about nine-twentieths* of its length from the body, which is, in this case, about $7\frac{1}{2}$ inches. In applying M. Chabrier's formula to actual cases, Mr. B. has imagined the wing to oscillate in an arc of 120°. Perhaps that arc can hardly be so great; such observations as the case admits seem not to warrant the supposition; and great waste of power, as to sustentation, would occur, on any supposition, in the upper and lower portions of so large a stroke. I think it will be nearer the truth to suppose it to extend only to 90°, and perhaps that is a little too much. From these particulars it follows, that the path of the centre of effect is 5·915 inches long.

Let us now collect the data for ascertaining the effect of the wings, considered not as flappers, but as sustaining planes. It is a matter of easy and constant observation, that the body of a bird is always inclined to the line of flight; if that line be horizontal, the head of the bird is higher than its tail; if the body of the bird become horizontal, the flight changes to a descending line, and so on. The like seems to be true of the position of the wings. In my last I gave reasons for assuming the angle of the wings with the line of flight to be 5°. Sir G. Cayley, the best authority to be quoted on this subject, says that the velocity of the rook is 34·5 feet per second, and that it moves its wing up and down in flying over 12·9 feet; which statements, taken together, agree nearly enough with Mr. B.'s estimate of the actual rapidity of the beats. If we suppose the upward and downward beats to be performed in equal times, the bird will pass over 6·45 feet, or 77·4 inches, while it makes the downward stroke.

Having now the length of the two paths, for the same space of time, we can easily see what is the sustaining effect of the wing on either supposition; for we may learn the pressures at the two angles, at the same velocity, from Hutton's table quoted in my last; and they vary also as the squares of the velocities,—that is, as the squares of the length of the paths described in the same time. In the downward action, as M. Chabrier supposes it to take place, the length of the path is 5·915 inches, and the pressure at 85°, by Hutton's table, may be represented by the proportionate number 839; the effect may therefore be denoted by ($5{\cdot}915^2 \times 839 =$) 29302. In the other kind of action, that on which Mr. Henson relies, the length of the path is 77·4 inches, and the pressure is represented by 15*; its effect is, therefore expressed by ($77{\cdot}4^2 \times 15 =$) 89860, or the sustaining effect of the impingement of the air on the inclined under surface of the wings, is, in this case, more than three times greater than that derived from the direct downward stroke.

But this is not all. The theory of M. Chabrier very properly reckons as a subtractive force the resistance of the air to the upward stroke of the wings; it ad-

* More accurately, 0·45643 *l*.

* I ought to remark here that the force represented by 15 is not that in the vertical direction, which serves to sustain the bird, but that in the horizontal, which retards its flight. I have already pointed out the necessity of further experimental inquiry into this subject. In the absence of better knowledge, I have used this amount to represent the sustaining force, although it is probably much below the truth. If the fluid were in a condition to act equally in all directions, the horizontal pressure of 15 would be accompanied by a vertical one of 171·45, or $\frac{15 \cos. 5°}{\sin. 5°}$. So little, however, is known on this subject, that all these deductions must be taken subject to future correction, and can only be considered useful in so far as they point out the path by which the exact truth may probably be found hereafter.

mits, in fact, that whatever is lost by this upward stroke, has to be regained by the downward one, before any force is available for the lifting of the bird; and to make out an available balance, it supposes the wing to be of smaller area, and to move more slowly in the upward than in the downward stroke. It is not easy to say to what extent either of these habits obtain; in the pigeon, both may be pretty plainly observed; but I have watched in vain for them in the rook; indeed I have sometimes thought that the latter bird makes the upward stroke most rapidly. Be these facts, however, as they may, the "skimming" theory of the wing has no such deduction to make; according to it, the wing still continues to act with effect, during the time that, by the "flapping" theory, it is actually damaging the effect of its own previous efforts. Add to this, that some support is derived from the pressure of the air on the sloping under surface of the body of the bird, as well as of its wings, (which is entirely omitted in the theory under review,) and we shall, perhaps, not be wrong in concluding, that the sustaining power of the wings and body, considered as inclined planes striking the air in the flight, is five or six times greater, in the case before us, than that derived from the vertical motion of the wings.

Two questions here present themselves:—first, Does the flapping of the wings interfere with their action as sustaining planes? and secondly, What is the use of the flapping? To the first of these it may be answered, that whatever decrease of effect arises from the wing, while it rises, evading to some extent the impact of the air, is made up by an increased effect during its descent. A wing 6¼ inches wide, and inclined 5 degrees, will have its front edge ·566 inches higher than its hinder one; while the bird passes over the breadth of its wing, or 6¼ inches, the centre of effect will be elevated 0·496 inches; it follows, therefore, that a particle impinging near the front edge will not find the wing rising quite fast enough to allow it to glide without pressure along the under surface, so that even the upward stroke is not entirely without sustaining effect at the centre of effect of the wing, while all between that centre and the body, comprising the greater part of the entire area, approaches still more nearly in action to a fixed plane.

While the flapping of the wings then, does not unfit them for sustentation, it brings them into action as propellers. The more flexible feathers which compose the back edge of the wing, and particularly the large and long ones of the outer end, bend under the stroke, and form short steep surfaces inclining upwards at the back. The action of the air upon these, I conceive, is exactly analogous to that of Mr. Henson's propellers. This is no new explanation of the propulsive action of the wing: I give it merely for the sake of the requisite completeness of explanation.*

It seems, Sir, to me that we shall find in the proportions of the wing a strong confirmation of this view of its office. Near to the body, where its motion is small, it has the greatest breadth. Now with that economy of means which is observable in all the works of the Great Artificer, we should have found the greatest breadth at the outer extremity, if the flapping theory had been universally true; for a given weight of material and expanse of surface would produce the greatest effect when placed there. But the wing, as actually proportioned, is just fitted to act the parts at once of a sustaining plane and a propeller: the great breadth near the body, where there is little interference with the uniformity of its sustaining effect, as well as little motion to incur fatigue, qualify it for the former,—the strong and flexible feathers of the extremity, where the motion required to produce the intended effect is necessarily the greatest the wing admits, equip it for the latter office.

If then the flight be so easy an operation as this view of the matter would seem to make it, to what purpose serves the immense muscular apparatus with which flying birds are universally endowed? To see this, let it be remembered that this argument has so far sup-

* It is worthy of inquiry whether the rotation of the outer portion of the wing, afforded by the radius and ulna of the bird's fore-arm, is not the chief means of changing the position of the long feathers of the extremity of the wing, when the stroke changes from upward to downward, and *vice versa*, so as to bring them into proper positions for propelling, during both portions of the double stroke. It is remarkable that this power of partial rotation should be given only to the extremity of the wing, the greater part of the area of feathers being, if I am not mistaken, attached to the humerus and ulna which do not rotate, or if at all not so largely. At present it seems to me that the anatomical structure of the wing favours the view here taken of its functions. The subject deserves further investigation.

posed the bird or machine to be already in motion, and that motion to be kept up by the propelling action of the wings. Now I conceive that this great muscular power is necessary in order to sustain the bird, *by an action which is correctly explained by the theory of M. Chabrier*, while it obtains the needful horizontal velocity: as soon as that is obtained, this extra exertion ceases; whenever from any cause it has been diminished, or higher speed is desired, this reserved muscular power is again drawn on. Confirmation of this view is obtained from two or three facts. A bird which desires to remain stationary over one spot, as a hawk watching for prey, or to ascend perpendicularly, as a singing skylark, has to make beats apparently as frequent as M. Chabrier's theory requires; this is a prolonged exhibition of the initial effort of every flight which has not the advantage of a descent, and shows the correctness of M. Chabrier's views as applied to that part of the case; and here is evidently the expenditure of a large amount of force provided for by the large outfit of muscle. But the moment the hawk or lark "goes a-head," this violent and frequent flapping gives place to the slow and easy strokes required to maintain the velocity, and then also the applicability of M. Chabrier's theory ceases, and we must obtain an explanation of the observed facts from the other view of the subject. And so also with the starting effort of every unassisted flight. To this also agrees the fact that nearly all muscles are incapable of continuing for a long time their utmost efforts, although they will keep up a lower degree of exertion for an extended period. If both these explanations of the working of the wing, each in its place, be true, the heavy demand on the muscles of the bird is soon over, and the flight of long duration is kept up by gentler efforts of the very same parts, in close analogy with what we observe of all other muscular capability and action.

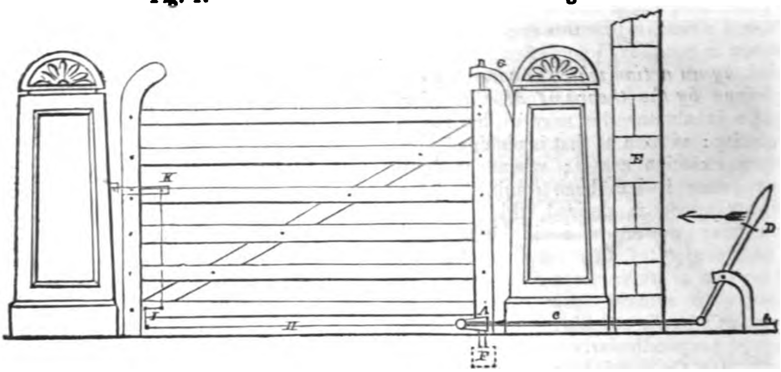
But in all probability the flight of different birds is effected by the operation of both these principles compounded in different proportions. I have chosen that of the rook for illustration, because it is of tolerably easy observation,—because, by the care of Sir G. Cayley, and Mr. Bishop, we have important data respecting it,—and because its journey-flight (if I may by that term distinguish its continued from its starting efforts) seems to depend, perhaps, less on the downward pressure than that of some other birds. My object is to illustrate the principles of Mr. Henson's machine, and if that can be made to fly on the plan of any one bird, rook or other, all the rest of the matter may be either let alone, or soon learned and applied.

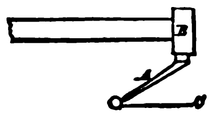
If I do not over estimate the force of the observations I have made, I have shown that M. Chabrier's theory applies to the starting of a bird,—that that starting requires the great power his formula demands for it,—that when the due velocity is attained, Mr. Henson's principle replaces M. Chabrier's, and the power required is very greatly reduced. To apply this to Mr. Henson's machine, let us suppose a bird willing to fly only from and to specified points, and his muscular system divided in two parts, such that, when they are united they supply the full amount of starting power, but when separated, the smaller of them would suffice to continue the flight. Let us further suppose the bird to leave behind him, as soon as his horizontal velocity is attained, the larger part which had assisted in the start, and we have in all its essential particulars the plan of Mr. Henson. The large power required for starting he supplies by a stationary contrivance, inclined plane or other, and the sustaining power he carries with him. Whether he will succeed, is yet to be determined; but it is some encouragement to find that in every argument against the possibility of his success which has yet come under my notice, not excepting the ablest, there is a distinct and demonstrable flaw, occasioned by want of more exact and comprehensive knowledge of the physical facts on which the question depends, than we yet possess. Those parts of his contrivance to which the subject discussed in this paper applies most obviously, are the great sustaining planes and the propellers. I hope what I have here advanced, will show that in them he has followed nature more nearly in principle than in appearance. The properties of our materials and known sources of force will not perhaps at present admit a closer approximation to the exquisite models which float above us; whether a nearer approach will ever be made, is yet in the hopeful but impenetrable futurity of science. L. L.

6 A, Lisson-grove, May 24, 1843.

IMPROVED TURNPIKE GATE.

Fig. 1. Fig. 2.





Sir,— On perusing a modern work on architecture, the other day, I perceived in it two designs for opening and closing turnpike gates, without the necessity of the keeper leaving his room, and copied from an early volume of your Magazine. The apparatus pertaining to one, (the Scotforth gate,) is extremely complex and inconvenient, and, according to the keeper's account, did not work well; the other, designed and forwarded by Mr. M. Saul, of Lancaster, is much more effective, but is very complicated and expensive, owing to the number of wheels employed, and the inconvenience of making a tunnel across the road.

The prefixed design exhibits a simple mode of effecting the same object, at a much less expense, as both the tunnel and bevel wheels are dispensed with. A, is a lever, fixed near the bottom of the main post of the gate, forming an angle of 45° with the bottom bar: this lever carries a ball and socket joint at B, to which the rod C is attached, communicating with the hand-lever D, supposed to be within the house, of the front wall of which E is a section. The gate, instead of being hung in the usual manner, is supported at the bottom by a rod of iron, which works in a hole in the stone F, which is sunk beneath the surface of the earth. Another rod projects from the top, and works in the support C, fixed to the top of the pillar.

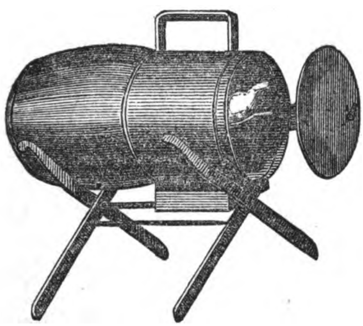
From the preceding description it will easily be seen, that any motion of the lever D must produce a corresponding motion of the gate, opening or shutting it as required. Some mode of keeping the gate fast when closed, is, however, still wanting. The following is, perhaps, as simple a plan as possible.

To the end of the lever, at B, is fixed a rod H, which, through the bell-crank I, communicates motion to the catch K, lifting or lowering it according as the gate is required to be opened or shut, provision being made to allow this to move to lift the catch, before the gate begins to open.

It will be seen that the plan I have described possesses many advantages over both of those first referred to, not the least of which is the dispensing with the tunnel, by placing the hinge end of the gate next the house where the keeper resides. The position of the lever is shown in the diagram, fig. 2, in which B is a horizontal section of the gate, A the lever, and C the rod for moving it. Another plan would be, instead of the lever, to fix a spur wheel upon the centre, which supports the gate, to be worked by a rack upon the rod C; but that would be rather more expensive. Yours truly,

Preston, April 12, 1843. WILLIAM JOHNSON.

Fig. 4.



In all reflecting ovens hitherto invented, where the food is placed between the fire and the reflector, the food itself is the chief obstacle to the dressing, as it intercepts all rays of heat from the reflectors behind, as may be seen from inspection of the accompanying diagrams, figs. 1 and 2; fig. 1 being a sectional view of a common Dutch oven, and fig. 2, the like of the improved American oven. To remedy

Fig. 1.

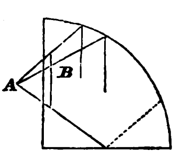


Fig. 2.

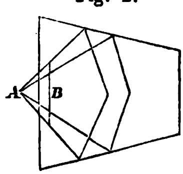
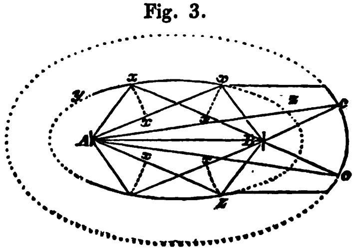


Fig. 3.



this defect Mr. B. Wall, Mathematical Teacher, has constructed an oven on the more correct principle developed in the following demonstration:—

Let A and B, fig. 3, be the two foci of an ellipsis, and *x x* perpendiculars raised upon any parts of the interior concave circumference *y x z;* then, because the angle of incidence is equal to the angle of reflection, every indirect ray of light or heat emanating from the fire at A, will be reflected from the points *x x*, to the food placed in the other focus at B; and consequently the same taking place from every part of the interior circumference, the greatest heat will be collected at the latter point. The reflector at the back being also a section of an elliptical curve, having the same foci, all rays passing from A to *c c*, will be reflected back to B.

An external elevation of a reflecting oven on this principle is shown in fig. 4. The inventor claims for it a great many advantages—more, perhaps, than will be generally allowed—but the following are such as one would reasonably anticipate:

"1st. The perfection with which the viands, subjected to its influence, are dressed; being placed at a distance from the fire, the condensed rays of heat expand the pores, and render the meat tender and easy of digestion, instead of dry and hard; the juices are not carried off by evaporation, neither is the meat covered with coal gas or smoke.

"2nd. Its cleanliness; no ashes can fall into the pan; neither in the cooking can any grease splash the most polished grate.

"3rd. A great saving in fuel; in consequence of the condensation of heat at the point B (see fig. 3), only half the usual quantity of fire is necessary."

We subjoin Mr. Wall's "*Directions for Use.*"

"Place the mouth of the oven before a clear fire, that the smoke may not tarnish the reflector. For roasting—take out the oven plate, and put the joint upon the stand, without a dish or other impediment to the reflection. For baking, have a little better fire than for roasting, and keep the space beneath the oven-plate clear; should the loaf or pie be liable to burn, put the oven-plate on the upper shelf; if not brown enough, lower it. In both cases keep the oven in a line with the fire."

Also his "*Recipe for Cleaning the Oven.*"

"Take one pound of common soda, half a pound of fresh slacked quicklime, and three pints of boiling water; stir them well together in a pan, until the soda is dissolved. Mix some of the above composition with whiting, to the consistence of cream; rub it till you think it sufficiently clean, and then wash it off with clean water, and wipe it dry with a clean leather or soft cloth; the oven will then be as brilliant as when new."

WHITELAW AND STIRRAT'S WATER MILL.—STEAM-ENGINE POWER REQUIRED TO WORK MACHINERY OF DIFFERENT KINDS.

A second edition, "greatly enlarged," of Mr. Whitelaw's little work* descriptive of the construction and capabilities of the water wheel of which he is joint patentee along with Mr. Stirrat, brings the merits of that remarkable machine once more prominently before us, and presents us at the same time with some very valuable information on the cognate subject of "the steam-engine power required to work machinery of different kinds."

The water-mill itself, both in its original form, and as subsequently improved, has been already fully described in our pages (see Nos. 904 and 984); and at present, therefore, we need only apply our attention to the proofs which are here collected of its commercial value as an instrument of mechanical power. The first we meet with, and one of the most striking also, is an account of a mill erected in April of last year, at the suggestion of William Cubitt, Esq., C. E., for the Chard Canal Company.

"This machine is used for hauling boats up an inclined plane of 810 feet in length. The plane has a rise of 1 foot perpendicular in 10 horizontal. The weight of the boat, cargo, and the cradle in which the boat rests, is 18 tons; and, when the machine is fairly started and working up to its speed, this weight is raised 16·9 feet perpendicular each minute. The height of the fall which works the water-mill is 25 feet, and 725 cubic feet per minute is the quantity of water used by the machine. Now,

$$725 \times 62{\cdot}3 \times 25 = 1129187{\cdot}5$$

will represent the power of the water, and the power of the water-mill will be represented by

$$18 \times 20 \times 112 \times 16{\cdot}9 = 681408. \text{—} \therefore 1129187{\cdot}5 : 681408 :: 100 : 60{\cdot}35;$$

that is, the machine gives 60·35 per cent. of the power of the water which works it; and, in addition to this, it overcomes the friction of the other machinery, which takes the boat up the inclined plane.

"Mr. Sydney Hall, who, under Mr. Cubitt, superintended the works on the canal, and who, with great care, experimented on the machine, in his report on the subject, estimates, that 96 of the 725 cubic feet of water used by the machine are lost by the escape at the water-tight joint. But, supposing this loss of water to amount to 75 cubic feet per minute, then 650 cubic feet of water will be left to work the machine. Now, if 650 cubic feet be the quantity of water expended at the jets, the result will be a power equal to 67·3 per cent. of the power of the water used by the machine. This will be evident by making a calculation in the manner done above. This last is a very great result, for, if we suppose the power of the machine to be 75 per cent., then 7·7 per cent. only will be the quantity of power required to overcome the friction of bevel-wheels, shafts, drums, guide-pulleys, cradle-axles, and the other parts of the machinery which work the plane, and which do not form a part of the water-mill. Even if 725 cubic feet of water were used by the machine, only 14·65 per cent. of the power of the water would be needed to overcome the friction of the machinery for working the plane, and which does not form part of the water-mill, allowing the machine to give 75 per cent. of the power of the water.

"The framework which supports the water-mill is light, and made of wood, and the pressure of the water at the central opening causes it to bend; the consequence is, that the machine is separated from the part of the water-tight joint which is in the main-pipe; this is the cause of the great escape of water, and it can readily be prevented. Although the loss from escape of water at the joint is great, yet the result is very satisfactory.

"Mr. H. made eight different experiments during the passage of as many boats up the inclined plane, and the result was the same in each case. A small pond, which is at the top of the fall, alone supplied the machine at the time of an experiment. The surface of this pond was accurately measured, and the distance the water fell in a given time, gave the quantity expended.

"From 60 to 63 revolutions per minute is the speed of the machine. The diameter, measuring from centre to centre of the jet-pipes, is 9·55 feet; 11 inches is the diameter of the arms, and ·412 foot is the diameter of each jet. The central opening has a diameter of 23¼ inches. 26 inches is the diameter of the main pipe."

* "Description of Whitelaw and Stirrat's Patent Water-mill; with an Account of the Performances of a number of these Machines. To which is added, Information on Water Power, and other subjects related to the above. By James Whitelaw." 64 pp. 8vo. With seven plates. 2nd edition, greatly enlarged. London and Edinburgh 1843. 2s. 6d.

From Mr. D. Dove, of Rosehill, near Glasgow; Mr. Thos. Baird, of Kirk St. Anne, Isle of Man; and Mr. W. Thompson, of Hazlewood Hall, near Tadcaster, there are letters showing that Messrs. Whitelaw and Stirrat's mill, when applied to the driving of thrashing machines, does much more work, with an equal quantity of water and height of fall, than an overshot water-wheel. Mr. Baird estimates the balance in favour of the new mill to be equal to 30 bushels per hour, or a saving of one-third.

Mr. W. Peel, of Taliaris Park (Carmarthenshire) gives an interesting account of a mill of this sort, erected under his own superintendence, by a common carpenter (for what particular purpose is not stated), which has more than realized all the expectations he had ever formed of it.

"It appears to me so simple in its construction, and likely to be so durable, both on account of that simplicity, and the little friction it sustains when at work, that I do not calculate upon its wanting any repairs for the next ten years, except perhaps the renewal of the brass collars in the plumber-blocks, which must wear in all machinery. * * * It works with the nicest regularity, and the governing valves are so quick in their operation, that when we turn off or throw on any additional machinery, no sudden acceleration of speed or check is observable. * * * One of its greatest advantages, in my opinion, is its utility in rendering a small stream available, where a high fall can be attained, to obviate the difficulty arising from the scarcity of water."

Mr. Peel expended on this mill 205*l.* 14*s.* 7*d.*; he calculates that one on the common plan would have cost him at least 800*l.*

Among several other letters, all in the same approving strain, there is one from Mr. Donaldson, of the Ballaughton mills, Isle of Man, which we must extract at length, on account of the detailed comparison which it contains between the work done by a Whitelaw and Stirrat mill, and another of the common sort; both erected on the same stream of water, within 400 yards of each other.

"Ballaughton Mills, Isle of Man,
"10th April, 1843.

"Dear Sir,—Having one of your patent water-mills, and feeling particularly well pleased with its working, I have been testing its power, by drawing a comparison between our mill and Pulrose Mill, situated above 400 yards below us, on the same stream of water. The following results will convince every person who understands the subject, that your patent water-mill will work to very great advantage on a low fall, compared with the common water-wheel, and any person desirous to see both mills at work can satisfy himself at any time by calling on me:—

"Our fall of water is 8 feet 6 inches, and the water-mill is 9 feet 6 inches diameter—it has 4 arms, and works in tail-water. When the 4 arms are open we drive 6 pairs of stones, each 4 feet 8 inches diameter, viz.: 2 pairs grinding wheat, 2 pairs barley, 1 pair making oatmeal and sifting at same time, and 1 pair shelling oats with the scree and fanners. With 3 arms open—2 pairs wheat, 1 pair barley, and 1 pair oatmeal, as before. With 2 arms open—2 pairs wheat, and 1 flour cylinder. With 1 arm open—1 pair wheat, and 1 flour cylinder. Our flour cylinders are 18 inches diameter and 7 feet long. The quantity of wheat we grind per hour on each pair of stones is 6 bushels, and of barley 4 bushels, and oatmeal 10 cwt.; on each cylinder, 16 cwt. of fine flour. It may be as well to observe, that all our barley is kiln-dried before grinding, and is ground into a very fine flour for making bread; consequently it is much harder and takes more power than wheat. The speed of the water-mill, when working as above, is exactly 54 revolutions per minute, our stones 108 revolutions, and our flour cylinders 470 revolutions per minute.

"Pulrose Mill has a fall of 7 feet, and is worked by an undershot* water-wheel 15 feet diameter and 5 feet wide. It is only four years old, and is made upon the very best principle, and there is no loss of water between the two mills. When our 4 arms are open, at Pulrose Mill they have more water than they can consume. Our 3 arms give the exact quantity required by them to drive 1 pair of wheat-stones, 4 feet 6 inches diameter, grinding 5 bushels wheat per hour; and 1 pair barley, grinding 3 bushels per hour. When our 2 arms are open they have barely enough of water to work 1 pair of wheat-stones, and 1 flour cylinder (16

* Mr. Donaldson calls the water-wheel at Pulrose Mill undershot, for the reason, that the action of the water is all below its centre: but it would be more strictly characterised as a breast-wheel. The buckets have a form similar to those of an overshot wheel, and they keep close to a circular arc, running from the bottom of the lead to the lowermost point of the tail-race; consequently the water acts in the same way as in an overshot wheel. The wheel is of the construction most approved of for a height of fall and quantity of water the same as at Pulrose Mill.—*Mr. Whitelaw.*

inches diameter by 5 feet long) dressing 8 cwt. fine flour per hour. When one of our arms is open, they are scarcely able to grind 3 bushels of wheat per hour, without any other part of the machinery at work.

"ROBT. DONALDSON."

No doubt can now exist that the Whitelaw and Stirrat mill is a really good thing, and well deserving of the preference which, we are glad to learn, is beginning to be very generally given to it, wherever any new machine for the application of water power is required.

The portion of Mr. Whitelaw's pamphlet which relates to "the steam-engine power required to work machinery of different kinds" commences with a very excellent paper on the subject, which first appeared in our pages, (No. 958,) from the pen of Mr. John Baynes, of Park-place Works, Blackburn. Mr. Whitelaw, on seeing this paper, wrote to Mr. Baynes for explanations on several points, and the following is Mr. Baynes's reply.

"Park-place Mills, Blackburn,
"September 14, 1842.

"Mr. James Whitelaw.

"Sir,—I duly received your favour of the 7th instant, and have great pleasure in answering your inquiries; but not having a spare Magazine at hand, I shall be obliged to refer to the tables,* and give the desired information on this sheet.

"1st. The throstles experimented upon are the common throstle, spinning 34 twist for power loom weaving; the spindles revolve 4,000 per minute.

"2nd. The self-acting mules are on Sharp, Roberts, and Co.'s principle; about one-half spinning 36's weft, and spindles revolving 4,800 per minute. The other half spinning 36's twist, spindles revolving 5,200 per minute.

"3rd. The hand-mules were spinning about ½ and ½ 36's weft and twist. Weft spindles 4,700, and twist spindles 5,000 revolutions per minute.

"4th. The average breadth of the looms would be 37 inches, *i. e.* weaving 37 inch cloth, making 123 picks per minute. All common calicoes about 60 reed, Stockport count, and 68 picks to the inch.

"By common sizing, I refer to the plan of warping by the hand, and sending the warps to be sized out of the mill; consequently, there is no power consumed by the sizing. Where the plan of dressing the yarn instead of sizing is adopted, one horse power cannot drive so many looms, as the dressing machine will absorb from $\frac{1}{8}$th to $\frac{1}{7}$th of the power.

"The patent sizing (Hornby and Kenworthy's, of this town) is intended to supersede dressing. One patent sizing machine will size as much as five dressing frames, with half the power of one dressing frame. This machine is a compound of the sizing and dressing plan; it answers better than sizing, but not so well as dressing. The engine-power which it absorbs is only small, the chief expense attending upon it being fuel, as it requires a large supply of steam to boil the size and dry the yarn.

"The remarks 'common sizing,' 'patent sizing,'' &c., were merely given for the information of the manufacturers in this neighbourhood.

"As regards the quality of coal in this neighbourhood, that varies very much indeed. Some manufacturers prefer using coal at 5s. 3d., others, 5s. 6d., 5s. 9d., 6s., 6s. 6d., 7s., 7s. 6d., and 7s. 9d. per ton, respectively, the latter being the highest price for the best coal

"There is a great similarity in cost per horse power (indicated) in the use of such a great variety of coal. I refer you to experiments at page 37.

EXPERIMENTS.

Nos.						
3, 4	coal at 6s.	per ton	=2s. $3\frac{3}{4}$d.	per week,	each	indicated horse power.
5, 6, 7	do. 6s.	,,	=2s. $2\frac{3}{4}$d.	,,	,,	,,
2	do. 7s. 10d.	,,	=2s. $4\frac{3}{4}$d.	,,	,,	,,
8, 9	do. 5s. 6d.	,,	=2s. $4\frac{3}{4}$d.	,,	,,	,,
10	do. 5s. $4\frac{1}{2}$d.	,,	=2s. $6\frac{1}{2}$d.	,,	,,	,,

The average gives 2s. $4\frac{1}{2}$d. per week, per indicated horse power, cost of fuel. The average cost per week in fuel is

·095d., or $\frac{2}{21}$d. per hand-mule spindle, including preparation;
·125d., or $\frac{1}{8}$d. ,, self-acting mule spindle, do.;
·273d., or $\frac{3}{11}$d. ,, throstle spindle, do.;
2·8d., or $2\frac{3}{4}$d. good per loom, including winding and warping; or nearly 3d. per week, including sizing (patent.)

* No. 958, p. 483.

"The twin engines, 60 horses power each, are the steam-engines which drive these works;—no hand-mules; all Sharp, Roberts, and Co.'s self-acting mules, and 26 common throstles. We run above an average speed. We have also 6 of Hornby and Kenworthy's patent sizing machines to 800 looms. The sizing machines have not quite full work.

"I am, Sir, yours respectfully,

"JOHN BAYNES."

Mr. Baynes subsequently communicated to Mr. Whitelaw the following additional particulars.

"The two steam-engines, coupled at right angles, (see Nos. 3 and 4 in the Table,*) are those connected with this place. They are each 60 mechanical horses' power = 120 H. P., but indicate 222 H. P., and turn the following machinery:—

"20,000 self-acting mule spindles, Sharp, Roberts, and Co.'s; 5,400 spindles, common throstles; 800 looms, with winding, warping, &c.

"Preparation—3 double blowers and 3 lap machines, each 36 inches wide, beaters 18 inches diameter, and make 1,200 revolutions per minute; 120 single carding engines, each 36 inches wide, main cylinders 39 inches diameter, and make 120 revolutions per minute; 16 drawing frames; 600 slubbing spindles, revolving 400 times per minute; and 1,800 roving spindles, revolving 800 times per minute. Indicated 34 horses power.

15,000	weft self-acting spindles, Sharp, Roberts, and Co.'s,	revolving	4,900	per minute.
5,000	twist self-acting spindles,	,, ,,	5,200	,,
20,000	Indicated 61½ horses' power.			

"5,400 throstle spindles, (common,) revolving 4,000 times per minute. Indicated 44½ H. P.

"1250 winding spindles, with warping mills and sizing frames; and 800 looms, averaging 38 inches width of cloth, and 120 picks per minute. Indicated 82 horses' power.

	Indicated Power.	
20,000 self-acting spindles	61½	H. P.
Preparation	26½	,,
	88	,,
5,400 throstle spindles	44½	,,
Preparation	7½	,,
	52	,,
800 looms, sizing, warping, and winding	82	,,

"Since the foregoing experiments were made, there has been an additional quantity of work put on the two 60 horse engines, viz., 2,500 twist self-acting spindles, with preparation, making a total of

22,500 self-acting mule spindles, with preparation = 442 spindles per mechanical horse power;

5,400 common throstle spindles, with preparation = 200 spindles per mechanical horse power;

800 looms, with winding, warping and sizing = 19 looms per mechanical horse power.

"These engines are now fairly loaded. They are, together, 120 mechanical horses' power, but indicate 233 horses' power by M'Naught's indicator.

"Cost in fuel per indicated horse power, including that spent in warming the mill during the day, night, and on Sunday. (See table, page 37.)

No. 2,	,,	2s. 4¾d.	per indicated H. P. for one week.
Nos. 3 and 4,		2s. 3¾d.	,, ,,
,, 5, 6, and 7,		2s. 2¾d.	,, ,,
No. 8,	,,	2s. 4¾d.	,, ,,
,, 9,	,,	2s. 6¾d.	,, ,,
,, 10,	,,	2s. 11¼d.	,, ,, ,,

Mr. Whitelaw himself made a great number of experiments on the same subject, and details the results. The following extract may serve as a specimen; it contains much curious and valuable information:—

"1. Mill for twisting cotton yarn into thread.—In this mill there are 27 frames with 96 common throstle spindles in each, making in all 2592 spindles. The spindles turn 2200 times in a minute. 1⅜ inches is the diameter of the bobbins, and the part which holds the thread is $2\frac{3}{16}$ inches long.

"In addition to the twisting frames, the

* Mech. Mag., No. 958, p. 486.

steam-engine works four turning lathes; three polishing lathes; two American machines for turning small bobbins; two circular saws, one of 22, the other of 14 inches diameter; and 24 bobbin-heads, or machines for filling the bobbins with finished thread.

"The power required to drive the whole of the machinery is 28·5 horses. When the twisting spindles and bobbin-heads only are working, the power is 23·9 horses; and when all the machinery, except the spindles, is thrown off, the steam-engine works to a power of 21·1 horses. Therefore $\frac{2592}{21 \cdot 1} =$ 122·84 is the number of twisting spindles worked by each horse's power.

"When the diagram was taken from which the power required to work the spindles was calculated, there was also on the steam-engine the main gearing for the rest of the machinery. On this account, and also because the steam-engine was at the time only working to $\frac{3}{4}$ of its power, the number of twisting spindles which a horse's power will work, will be somewhat greater than 122·84, or a steam-engine of a little less power than 21·1 horses' would work 2592 twisting spindles, if the engine was just powerful enough to keep the spindles at their proper speed, and if there was no more gearing on it than what was required for the twisting machines.

"I may mention that the steam-engine is just powerful enough for the whole of the machinery: and I may state farther, that the whole of the bobbin-heads are driven by one main belt or strap, which can be worked either on a fast or a loose pulley; and that each turning-lathe has a belt above it, which may be put either upon a fast or a loose pulley; and when any portion of the machinery was stopped, this was done by shifting the belt or belts on to the loose pulley or pulleys.

"When the diagrams were taken, there were

96	of the spindles	twisting yarn,	of No. 24,	into	three-cord	thread.
48	,,	,,	30,	,,	three	,,
384	,,	,,	40,	,,	six	,,
48	,,	,,	44,	,,	three	,,
192	,,	,,	46,	,,	six	,,
384	,,	,,	50,	,,	six	,,
192	,,	,,	60,	,,	six	,,
576	,,	,,	70,	,,	six	,,
192	,,	,,	80,	,,	six	,,
48	,,	,,	90,	,,	three	,,
96	,,	,,	90,	,,	four	,,
48	,,	,,	100,	,,	three	,,
48	,,	,,	100,	,,	four	,,
48	,,	,,	110,	,,	three	,,
48	,,	,,	110,	,,	four	,,
48	,,	,,	120,	,,	three	,,
48	,,	,,	130,	,,	three	,,

And 48 spindles revolving, but not making thread.

"A three-cord thread is formed by a spindle which twists at once three yarns into a thread; a four-cord is done in the same manner, only in it there are four yarns twisted by the spindle; and a six-cord thread is made after three separate threads of two yarns each are finished in the manner above described, by twisting three of the doubled yarns together by a spindle. Three of the spindles which were making six-cord thread, were doing the first part of the operation for every one that was performing the other part; so that of the 1920 spindles which were making six-cord thread, there were 1440, each twisting two yarns into a thread, and each of the remaining 480 spindles was twisting three of these threads into one. The above is the description of work the twisting machines were doing at the time the diagrams were taken.

"Each turning-lathe spindle makes 4000 revolutions per minute; the spindle of each turning machine revolves 3500 times per minute; the speed of the circular saw of 22 inches diameter, is 1000 revolutions per minute; the 14 inch circular saw revolves 1200 times in a minute; and the spindles of the bobbin-heads turn 10,000 times in a minute.

"One American turning machine does as much work as three turning-lathes. Small bobbins for holding the finished threads were making at the turning machines; at two of the lathes the wood was reduced to a shape suitable for the turning machines; at one lathe the holes were bored through the wood for the bobbins; another lathe had a cutter on the end of its spindle, and by it a small projecting part, which could not be taken off the ends of the bobbins by the turning machines, was cut off; at the rest of the lathes the ends of the bobbins for holding

the finished thread were polished; and at the saws the wood for the bobbins was cut to the proper size.

"I have been particular in describing the machinery in this mill, as it may serve for a guide in other cases. When 2592 spindles are making six-cord thread, and when 300 yards of finished thread are put upon each bobbin, the 24 bobbin-heads, the number of lathes and turning-machines already mentioned, and the two saws, will be sufficient for keeping this number of twisting spindles at work; but when the 2592 spindles are twisting yarns into some other kinds of thread, 12 additional bobbin-heads will be required, and also an additional number of turning-lathes, &c."

Mr. Whitelaw's mode of calculating the engine power, it should be observed, differs a little from that followed by Mr. Baynes, and explained in his first letter. It will be readily understood from the following illustrations:—

"*Example.*—Let the diameter of the piston of a steam-engine be 20 inches, the mean effective pressure on each square inch of its surface 15 lbs., and 200 feet per minute its velocity. Here,

$$\frac{20 \times 50 \times \cdot 7854 \times 15 \times 200}{44{,}000} = 21 \cdot 42.$$

Therefore, 21·42 horses is the power of the steam-engine.

"If $7\frac{1}{2}$, instead of 15 lbs., were the mean pressure on each square inch of the piston, the calculation would be made in the same way as the above, only $7\frac{1}{2}$ would be used in place of 15—thus

$$\frac{20 \times 20 \times \cdot 7854 \times 7 \cdot 5 \times 200}{44{,}000} = 10 \cdot 71$$

Therefore, 10·71 is the power of the same steam-engine when $7\frac{1}{2}$ lbs. is the mean effective pressure on each square inch of the piston.

As 56,000 is nearly $= \dfrac{44000}{\cdot 7854}$, the above and other similar calculations would be simplified by throwing ·7854 out of the numerator, and taking 56,000 in place of 44,000 for the denominator. Take an example in which the diameter of the piston and its velocity are the same as above stated, and 15 lbs. per square inch is the mean effective pressure. Here

$$\frac{20 \times 20 \times 15 \times 200}{56000} = 21 \cdot 428.$$

Therefore, 21·428 horses is the power of the steam-engine, which is nearly the same as was obtained by the other mode of calculating."

Mr. Whitelaw states that he has made other experiments on steam-engine power, besides those the results of which are here given, which he intends publishing "as soon as he can spare time to do so;" when he will also furnish "the divisors which should be used when a steam-engine is working at any point below its full power." We are sure all who are practically interested in steam-engine power will join us in earnestly wishing that the "spare time" may come soon. A few pages of such *matter-of-fact* information as Mr. Baynes and Mr. Whitelaw have supplied, are worth whole libraries of theoretical calculation.

EXPERIMENTS AND OBSERVATIONS ON MOSER'S DISCOVERY.

Proving that the effect is neither due to Light nor Heat.

BY HORATIO PRATER, ESQ.

[From the *Athenæum*.]

It is proposed now to demonstrate, that the radiation discovered by Möser is not invisible light, as he supposes, nor heat, as has since been supposed. For, first, where is the evidence that bodies absorb light? Some few, certainly, have been shown so to do; but surely not the metals, &c., &c., which exhibit the greatest facility in receiving and giving the impressions discovered by Möser. It seems, *à priori*, more probable that the radiation in question should consist of heat (which we know exists in all matter) than of light. Accordingly, Mr. Hunt has written an elaborate paper in favour of the supposition that such radiation consists of heat. In the course of this essay, however, it will appear, that neither of these suppositions is correct.

1. *With regard to the nature of the substances that produce spectra.*—Every substance I have tried has produced its spectrum when left on a polished copper plate. Coins, whether of gold, silver, or copper, platinum, nickel, brass, pieces of glass, wafers (red, blue, and white,) peppermint or rose drops, whalebone, talc, gum, a horse-hair ring, lava from Vesuvius, Indian rubber (but slight), and sealing-wax. This last, left ten days, gave a whitish grey *permanent** spectrum, clearer than any of the others, though the

* By a *permanent* spectrum is always meant, in this essay, a spectrum that remains when the substances or coins are removed—not a spectrum which cannot be rubbed off by *gentle* friction, for all the above *permanent* spectra are yet soon effaced by friction.

wax and plate were both kept dry as usual. The impression on a small brass seal (a P) was very obvious when the plate was breathed on. The seal had been left ten days.*

2. *Effect of dissimilar metals.* It has been asserted, that when a gold or silver coin is placed on a copper plate, the effect is greater than when a copper coin, &c., is placed on the same metal. When heat is used, this position is true, as will be shown hereafter; but when the plates and coins are both kept cold, (exposed to external air, for instance, in March,) a farthing, on two different occasions, in an hour, left as good a spectral image as a sovereign,—I thought, a better one.

It was, however, remarkable, when a heat of 160° was applied to this plate, that the spectrum of the copper soon became invisible, while that of the gold was apparently not at all diminished. This experiment was repeated twice with the same result. I likewise found that, though the spectrum of the copper was to appearance, *at first*, as good as that of gold or silver, yet that it began to disappear much sooner, after a few breathings on the plate, than did the spectrum produced by gold or silver. *On the whole*, therefore, it seems right to admit that the effect is greater when dissimilar metals are used.

3. *Effect of unequal heat on the plate and coins.*—It has also been asserted, that when the copper coin is heated, and the metal plate of copper kept very cool, that the effect is increased. I have, however, not been able to satisfy myself of the truth of this statement. A penny and a farthing, heated to between 130° and 160°, and laid on a cold copper plate half an hour, did not appear to leave even so good a spectrum as two of the same coins left to cool for half an hour outside the window, by the side of the plate itself, before being placed on the plate. All the coins were placed on the plate at the same time, and left the same time. Neither could I perceive any difference when one sovereign was heated and the other not, both being placed on the same copper plate.

4. *Effect of heat generally.*—In order to ascertain whether heat hastens the impression, the following experiments were made: 1. A bright half-sovereign, a bright half-penny, and a dull one, were heated to about 150° on a polished copper plate. The half-sovereign left a *permanent* impression; and both the half-pence left spectra visible only by breathing. It was obvious from this experiment and others, that heat increases the effect where *contact is permitted*,* since the impression is permanent. Accordingly it was deemed right to try if heat has this effect when the coin is at a distance from the copper plate.

I put a silver fourpenny piece on the plate, and on the fourpenny piece I put a penny. I found that when these remained only 24 hours, that no spectral image of the penny was produced; but on remaining forty-eight hours one was apparent. In this last case, the lettering of the fourpenny piece became almost visible when breathed upon; but not being breathed upon, no mark of it at all was perceptible. The penny piece, however, left its mark, without being breathed upon—an annular *bright* mark, which was not rendered more or less distinct by being breathed on. The spectrum of the fourpenny piece was alone brought into view by this.† The place where this had laid was as bright as that covered by the penny. In fact, the copper plate seemed preserved from oxydation by the contact and proximity of these coins. Thus, then, it appeared to require forty-eight hours for a spectrum of the penny piece to be produced—the spectrum of a coin *not in contact*. The same experiment being made at a heat of 160°, no spectrum of the penny appeared after one hour, though the fourpenny piece had left a strong impression.

Ditto, continued for five hours, a spectrum of the penny was *just* visible, and only so when the plate was held in a particular position with regard to light.

A half-crown piece being laid on a half-sovereign, and the same heat continued five hours on the same plate, the half-sovereign left a still better impression than the four-

* It left a permanent spectrum of its *margin*. Coins left a similar time do the same: *the part where they have remained retaining its polish.* The permanent spectrum, then, in such cases, plainly depends on the substances preserving the plate from oxidation by contact or proximity. I add proximity, because a half-crown or penny resting on a fourpenny piece, placed on the plate, likewise leaves its *permanent* spectrum. The free circulation of the air is impeded here in consequence of the extreme proximity, just as it is by actual contact. Hence the oxidation being less in all such cases than in the parts external to the coins, we have of necessity the permanent spectra.

* Although the mark is permanent in such cases, still it very easily rubs off, even when gold has remained five hours on heated copper plates; and no spectral figure is left when the part is breathed on, after the plate has been well rubbed. As this is the case, such permanent mark is not to be considered as a *different effect*, but only as a *higher degree* of the same effect as that caused by mere imposition without heat. I found all the things mentioned in Section 1, gave a *permanent* spectrum if left eleven days, but only one rendered visible by breathing, being left but a few hours.

† However, after six or eight days, *as this began to tarnish*, the spectrum of the fourpenny piece became visible without breathing on it. Yet nothing had been done, except that the plate had been heated to about 150° once or twice for other experiments.

penny piece* above mentioned, and the half-crown had also made a *permanent* spectrum very visible.

A farthing, which had rested the same time *on* the plate, left no permanent spectrum, but only one slightly visible by breathing. Even when pressed upon by two pence, and left eight hours, it left only a *barely visible* permanent spectrum: so a brass medal. These spectra being rendered far more visible by breathing, could hardly be considered permanent spectra.

These experiments show:—1st. That heat much increases the rapidity of the radiation, *even when the object is not in direct contact;* and 2ndly. That it takes place much more energetically from gold and silver than from copper (a copper plate being used). They also show that a permanent spectrum is to be considered only as a *higher degree* of that produced or rendered apparent by breathing.

A sovereign, two hours on a very thin lamina of talc, at the above heat, gave no spectrum; talc alone gave its spectrum; nor did a halfpenny, eight hours on the same at the same heat; nor a shilling (new) on a thin piece of glass, the shilling being under a halfpenny. The talc and glass in these cases alone gave a spectrum; the talc a better and more permanent one than the glass.† I should have said the talc was on copper-plate.

The spectrum of the penny, in the experiment lately detailed, is equally visible when the experiment is made on glass; but polished metals seem to show it the best.

When glass is used, there is, after from twenty-four to forty-eight hours, a slight deposition of dust, &c. around the parts which are not covered by the penny, and thus a round mark (permanent spectrum) is visible on removing the penny, even before breathing at all; still on rubbing it off *till nothing is visible*, and breathing on it again, the spectrum of the penny appears, as well as of the fourpenny piece, proving that dust adheres much more strongly than we should have supposed, or, perhaps better—leaves its mark behind with greater pertinacity.

That this is the true explanation of the appearance of a spectrum, when the coin is not in direct contact with glass, was to me rendered clear by another experiment, in which a half-crown was left on one sixpence, and a penny on another, on a clean glass plate *covered over with paper and kept in a closet* for ninety-six hours; yet on examination, neither a permanent spectrum, nor even an evanescent one by breathing, was perceptible either of the half-crown or the penny; the sixpences alone had left spectra (which, however, were only visible by breathing,) that under the half-crown being the clearest. Yet the penny and half-crown were in the best condition for giving spectra, for the surfaces of both were tarnished, and that of the copper purposely so.

This result induced me to try the same with a copper plate, and I found that when a bright half-crown (having been well boiled in water and then polished) was placed on a fourpenny piece, similarly treated, and left forty-eight hours *covered* in a closet as above, that the half-crown left no spectrum, even evanescent. Neither did a *purposely* tarnished penny placed on another fourpenny piece, and left the same time.

5. *As regards the distance from the plate at which images may be taken.*—A silver fourpenny piece is about the one-twentieth of an inch in thickness, and at this distance we have seen silver, copper, and of course gold, give a spectral image on a copper plate. But on putting a half-crown on two sixpences and a half-franc piece, making the distance from the plate more than the one-tenth of an inch, no spectrum of the half-crown was made, although the experiment was continued for twelve successive days and nights. Neither was any made by removing the half-franc piece (thus making the distance only one-tenth of an inch), and continuing heat of 160° or so for five hours.

A sovereign fixed at three-quarters of an inch, and a small brass medal at somewhat less than half an inch, from a polished copper-plate, and continued in such position for seventeen days and nights in a little closed deal box, gave not the least vestiges of spectra; neither did a fourpenny piece left at one-fifth of an inch, nor a card plate (engraved), left the one-tenth of an inch for eleven days. The copper-plate had remained *perfectly polished* in both experiments; and this is worthy of remark, as showing that in *confined* air copper does not oxidate perceptibly. Another plate left in the *same* room was completely tarnished in five or six days.

A fourpenny piece, about the one-twentieth of an inch, under a silver plate for eleven days, gave scarcely a perceptible spectrum; though a farthing, on which the plate *had rested*, gave a good spectrum, but not a *permanent* one, (*i. e.* breathing was required to show it.)

A fourpenny piece is about theone-twentieth of an inch in thickness, and this seems the

* When the plate was rubbed pretty strongly with chamois leather only, the spectra of the half sovereign and fourpenny piece were soon effaced: while those of the half-crown and penny (not having been in contact with the plate) remained.

† A sovereign on a silver fourpenny piece two hours, gave only a very feeble permanent spectrum; the silver leaving, of course, a well marked spectrum.

greatest distance an image can be taken by the above plan. But even at this distance I have not succeeded, if the half-crown laid on the fourpenny piece is *perfectly* polished, *and all external dust, &c. carefully excluded* by the box just mentioned—(see Sec. 8, on the comparative polish of metals).

6. *As regards impressions on glass.*—We have already observed that heat does not seem to increase the effect of *metal* coins on glass. Neither did *long contact;* for a fourpenny piece, left a *week* on a piece of looking-glass, only left the usual spectrum, no *figure* being visible. The same remark applies to large *printed* letters. At least, some paper with these, after remaining pressed two or three days without giving any impression, was then heated for five hours, so pressed, at about 160°, but no impression was made. On another occasion, print and writing were left a week on a glass mirror without leaving an impression. When, however, thinner paper and larger letters were used, and heat and pressure applied as above for four or five hours, these letters were plainly visible; but, as appeared to me, far more easily erased than were the spectra of *coins* on copper-plates.* A slight touch of the finger, for instance, erased the letters in question. They were produced in this case in consequence, no doubt, of the thinner paper being *moister* than that first used.

Heat does not appear to increase the effect on glass. A fourpenny piece under a shilling for three hours, at 160°, left no spectrum.

On putting a penny on a sovereign, and leaving them for three hours and a half at the above heat, I thought the spectrum of the penny slightly visible; but as the image is never so apparent as on polished metal, I shall not venture a decided opinion on this point as regards glass.

A *polished, boiled,* and then well dried half-crown gave as good a spectrum on a glass plate in twenty-four hours, as did a dirty half-crown; but I thought the spectrum of the former disappeared sooner by breathing. On a far thinner glass plate, a bright, boiled fourpenny piece, left the same time, gave no spectrum at all.

7. *Polished surfaces not appearing capable of receiving the impressions.*—These exceptions from the general rule I have found to be talc, and, among the metals tried, steel to a certain extent, platinum, and gold.

Whether heated or not with the coins on it, I have found *no* spectrum produced on talc, except in one instance, where a tarnished half-sovereign had been pressed some days by a half pound; and even here the mere margin of the coin was *barely* perceptible.†

On steel, after remaining twenty-four hours, I found a *very* slight evanescent spectrum produced by a small piece of brass, and on *one* occasion by a half-sovereign very much tarnished; but as heat did not appear to increase or hasten the effect, we may consider steel almost unsusceptible. The spectra just named disappeared entirely after breathing *twice;* and no *permanent* spectrum was produced, though the piece of brass above mentioned was placed even on the top bar of a grate, and of course kept very hot, for two or three hours.

Under the head 'Thinness of the plates,' experiments, showing the incapability of platinum to receive images, are mentioned.

The same remark applies also to gold. I kept a shilling and a farthing, on two different occasions, for twenty-four hours or longer on a well polished plate of gold, yet they *barely* left a marginal spectrum; and this spectrum, as in the case of steel, disappeared *entirely* on breathing on it twice. As the gold used was not free from the usual alloy of copper, possibly this was the cause of its receiving even the very slight spectrum it did. However this be, these experiments seem almost sufficient to establish the important general principle—viz., *that the less metals are oxidable by exposure to the air, the less is their susceptibility to receive spectra.*

8. *As regards comparative polish in metals.*—1. A new sovereign, a new half-crown, and new farthing (all well polished) were kept on a bright copper-plate, at 160° or above, on *two* successive occasions, for four or five hours. The gold and silver left only *very* slight permanent traces of their margin, the copper left none at all, but its spectrum, when the plate was breathed on, became, I thought, even rather more evident than the spectra of the gold and silver, these being likewise breathed on. 2. A *tarnished* sovereign and a *tarnished* half-crown being laid on the same copper plate, and kept at the same heat *only three-quarters of an hour,* a permanent and *far more apparent* spectrum was produced than in the former case; the *whole area,* where the half-crown had laid, was covered with a whitish cloud, and

* On a copper-plate also this *thin paper* (not being dried well first) gave a permanent and very visible spectrum, the lettering being clearer than on glass: not due to oxidation, for on rubbing it off, the surface of the copper was left polished—*i. e.* oxidation in the usual sense of the term; for there, no doubt, was some *very slight* chemical action, as large printed letters on perfectly well dried paper were not taken off on a copper-plate, the heat at 160° being applied for five hours; or on another occasion, the print remaining a week on the plate, and pressure being used.

† Talc, like platinum, is not easily acted on by acid.

the impression dimly sketched. 3. By selecting a halfpenny *very much* tarnished, and letting it remain five hours on a bright copper plate, heated to 160° or so, and subsequently for thirty-six hours in the cool, a *permanent* spectrum was produced, in which all the *lettering* of the coin was *beautifully* visible; yet here was copper on copper. But as I found this impression to go off completely at a heat far below what the impression did, at exp. 5, below, the general principle, that silver gives a *stronger impression*, remains. 4. A *well polished* new sovereign and a *tarnished* sixpence being laid on a bright silver plate for four hours, and kept at 160°, the sovereign had left no spectrum, but the sixpence had left a *permanent* one, in which almost all the lettering appeared, so plainly was it visible. 5. A *perfectly* polished half-crown was laid on a pretty well polished sixpence, and a *purposely* tarnished one on a purposely tarnished sixpence, and put on the same plate with the halfpenny (exp. 3, above), heated five hours and left thirty-six hours afterwards. The lettering, &c. of each sixpence was visible, but *far* more of the most tarnished; and also this was the case with that of the most tarnished half-crown, as regarded its spectrum. That of the polished was scarcely visible. But the lettering of neither half-crown was visible, though they had remained so long and been heated. This experiment also shows how much the effect is strengthened by *actual contact*. A similar experiment was made in the closed deal box (mentioned in Section 5). The copper plate was laid upon a *polished* and boiled fourpenny-piece, and this on a half-crown similarly prepared; after ninety-six hours no spectrum whatever of the half-crown was visible, by breathing or otherwise, but the fourpenny-piece, in actual contact, had left the usual spectrum. The plate had remained *perfectly* polished. All these experiments show that the dissimilarity of metals is not of such importance as has been conceived: they show the difference wanted to produce the effect is a difference in brightness or oxidation, *i. e.*, as far as a *permanent* and good impression, *showing the lettering*, &c. is concerned; for I find when left on the plate half an hour or so, tarnished or polished metals give equally good spectra. But in this case the spectrum is only made apparent by breathing, and of course shows *nothing* of the lettering, &c. However, even in this case, the spectrum of the tarnished sovereign disappeared less soon by breathing on it than did that of the polished one; so in reality the spectrum of the former may be said to have been the most perfect.

The same remark applies to a glass plate (see Section 6, as regards glass, &c).

9. *Which metal receives images fastest, copper or silver?*—My experiments lead me to say copper, whether heat be applied or not. When the same degree of heat was applied, I found a sovereign produced a good *permanent* spectrum (impression) on a bright copper-plate, although only an evanescent one (one seen only when the plate is breathed on) was produced on an equally well polished silver plate, placed at the same time at the same heat. When heat was not applied I found the copper received an *evanescent* spectrum first.

10. *As regards the effect of interposed substances.*—As every substance tried left a spectrum, I did not much expect that the influence would permeate any lamina, even of the thinnest description. Accordingly, when a sovereign or shilling was left twenty-four or forty-eight hours on a piece of stiff, though very thin, paper, it gave no spectrum, but the mark of the paper was alone visible. The experiment was repeated, half the coin resting on the copper-plate and half on the paper: and although it remained a fortnight in this position, the half only *in contact* with the plate was visible by breathing on the paper, leaving *its own* spectral image just as if no coin had rested on it at all.

The same experiment was repeated with the thinnest possible layers of talc, gum, cork, and whalebone, glass, plane, and concave,* with the same result. Each substance left its spectrum, the part where the coin rested on such layer not being at all distinguishable. The spectral image of the square piece of talc was perfect to the minutest outline, and left its straight mark under the sixpence equally well as at other points. These experiments render it clear that the effect is not due to latent light, for otherwise how could it happen that a coin does not leave a spectral image when left on *transparent* substances, glass or talc, *even a fortnight?* They also show it does not depend on heat (at least alone), for a heat of 160° soon passed through thin glass and talc, and I found it impossible to keep my finger on glass or talc so placed. Yet we have seen above that even gold left two hours on talc so heated left no spectrum, permanent or temporary. So great is the effect of interposed substances, that even a *slight tarnish* on the metal exerts a very obvious effect.† One shilling was left twenty-four

* With the glass the experiment was only continued forty-eight hours; with the paper, talc, and cork a fortnight, silver coin being used; with the whalebone and gum, ten days, gold coin being used.

† One spectrum, however, may be made on another; thus, after talc had remained eight hours on heated copper-plate, and left a permanent spectrum, a sovereign put on this an hour left a permanent spectrum.

hours on a polished part of the plate, and another on a part of the same slightly tarnished (but yet sufficiently bright to see oneself perfectly). A very slight image only was left in the last case, that entirely disappeared when breathed on twice, while that on the polished part of the plate remained, after being breathed on twelve or fourteen times.

A sovereign left twenty-four hours or above, tarnished, gave scarcely a perceptible spectrum, and a sixpence none at all. On such a surface a sovereign was left on two different occasions, under a penny, for three hours, at a heat of 160°, and barely left a permanent spectrum of its *outer* margin; while on a well polished surface, at same heat, the outline of the impression also would have been left as a permanent spectrum in an hour or two.

11. *Mass.*—Mr. Hunt considers, that mass exercises an influence and increases the effect. In my experiments, however, I could not detect this. A farthing on a copper-plate gave as good a spectrum as a penny, and when heated to 160° the farthing gave far the best, though the penny had a halfpenny laid on it. A fourpenny piece too gave as good a spectrum as a half-crown, pressed by another above it, in the same time, the contact being equally good in each case. *The contact in these cases was made as equal as possible with the copper-plate.*

12. *Does the thinness of the plate exert an influence?* A farthing (in two experiments) pressed by twelve or fourteen pounds weight, on a polished piece of platinum foil, in thirty hours left no spectrum at all; neither did it on a fourpenny-piece, or a sovereign, or half-sovereign, when kept three or four hours at 160° under the same weight. I found a spectrum could be made on nearly equally thin zink plates (zink *foil*), by leaving a sixpence on it an hour or two. Zink, not being elastic, allows the pressure to be equal. The particular chemical nature of platinum has, however, much to do with this effect; for I found that when a fourpenny-piece, or another small brass metal object was left on a highly polished lamina of steel, —heated to 160° or not—a spectrum was scarcely made. That elasticity and consequent *imperfect contact* is not the sole cause of the incapactity of thin lamina of platinum and steel, for receiving spectral images was to me rendered *probable* by observing that coins, placed on a thick copper-plate, seldom were in *perfectly* close contact, yet gave good spectra. In order to come to a more definite conclusion on this point, I got a lamina of bright copper, even thinner, and as elastic as the platinum lamina above mentioned. Gold or silver coins left twenty-four hours on this, gave a spectrum scarcely visible; but on leaving a half-sovereign for two or three hours on it, exposed to heat of 160°, as above, and pressed down by exactly the same weight, the half-sovereign left a *permanent* spectrum very well marked indeed.

The result of this experiment obviously shows, that although thinness and elasticity may have some little effect, the principal cause for the formation of the spectrum is the peculiar *chemical nature* of the metal, and *that a spectrum cannot be produced on a non-oxidable metal, such as platinum.* Bright silver and copper plates are well known to *tarnish* by exposure to the atmosphere (the former, perhaps, rather by forming a sulphuret than an oxide), but no matter how. I have also found that spectra could be formed on tin and zink plates, both of which, of course, are oxidable. So on copper coated with mercury, the mercury in such case no doubt readily tarnishing (see section 7, Polished surfaces not receiving spectra). Having decided that the effect in question is due neither to light nor heat, to what cause, it may be asked, is it to be ascribed?

Conclusions.—1stly, As *brightness* of the plate is indispensable, and with brightness must exist an *increased tendency* to tarnish, or enter into chemical combination; 2ndly, As the plate must be of an oxidable metal, and judging from the experiments with silver and copper the more oxidable the better; 3rdly, As the more perfectly the coins are cleaned and dried* the less the effect, and as a dry perspiration (so to call it) must exist in a greater or less degree on all coins, since they pass through so many hands, and as perspiration is slightly acid; 4thly, As even with *clean* coins the effect† by *actual contact* must be admitted, but still is greater when there is a difference in the nature‡ of the metal; and 5thly, As when the metals are not in contact (being removed only the one-twentieth of an inch apart), no action or spectrum is evident, if the free circulation of air, and the connexion with dust be prevented—taking all these and minor considerations into account, we come to the conclusion that the effect in question is dependent on a *chemico-mechanical* action, or what Berzelius has called *catalytic* action.

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* Moisture much increases the effect. Thus, when one surface of a shilling was rubbed over with ink, and such surface put on the copper plate and heated to 150°, a mark *much* more difficult to be effaced was left than when this degree of heat was applied without moisture.

† This is equally true, as will be remembered, with regard to glass plates.

‡ The *general* result of all the above experiments shows this: and of course an alteration of affinity from contact, is far more probable when metals are different than when the same; though if one be dirty, this makes it approach the nature of a different metal.

No doubt it may be urged against this view, that the action takes place when the coins and plate are both heated, and hence quite dry. But this is no solid objection, for the adage "Corpora non agunt nisi sint soluta" is not true, as hundreds of examples in chemistry show. The very fact of heat itself increasing the effect is all in favour of a chemico-mechanical view; for heat increases the tendency of copper to oxygenation, and tends also to volatilize any feeble acid matter on the coins. But again, if it be said the spectrum rubs off, even *when permanent and clearly defined* (as we have shown), *and leaves a polished surface under it*,—this we admit; but still this surface has suffered an *almost imperceptible degree* of oxygenation; for so slowly does this effect take place, that it is only visible when much advanced, as will be evident to any person who watches the gradual tarnishing of copper-plates. Möser's discovery shows that *very slight* chemical action is often going on, *which has been previously overlooked.*

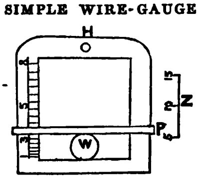
The chief difficulty that occurs to the above view is, that the effect takes place, to a slight extent, on glass; but in all my numerous experiments I have found that the effect is *much less* on glass than on well polished copper; for in no case has a *permanent* spectrum been made on glass, even by the longest contact.* It will also be remembered that I found no effect whatever produced on talc. Now the talc scratches easily, glass of course does not; but talc is probably less soluble in acids than glass; at least in my trials it did not seem at all acted on either by nitric, muriatic, or sulphuric. To be sure, you *perceive* no effect of these on glass, but it does not seem impossible but that some *very* slight effect takes place, and that the alkali of the glass is *very* feebly acted on, as glass is a *compound* body. *Contact*, at all events, may be presumed to have an influence on the affinities of one of its elements, whether there be even the *slightest* degree of decomposition or not. Now this influence is the catalytic influence; for it has been shown above, that without actual contact, *and when all dust is kept off*, neither silver nor copper, even at the one-twentieth of an inch from the glass plate, produces any effect, though kept there ninety-six hours. (See Section 4, of heat generally, end.) In consequence of this slight alteration in affinity, the parts of glass which have been in contact some time with coins or other substances, condense the breath differently from those parts which have not: hence the spectrum.

The effect of glass, *supposing it not susceptible of a gradual change by the action of air similar to oxidation*, is rather in favour of the spectrum depending on a mechanical than a chemical action. I have in consequence ascribed the effect to a mechanico-chemical action, or a *catalytic* action, meaning thereby an action so slightly chemical as, in the present state of the science, to be scarcely appreciable.* The attraction of glass and oxidable metallic plates for *dust*, &c., is very great; and is perhaps dependent on the same cause as their attraction for oxygen. Whether or not, I feel pretty well convinced, after a laborious investigation of the discovery in question, that it is not of that wonderful character that Möser and others have supposed; nor calculated to alter our ideas of vision or of the nature of light. On the contrary, I think with Fizeau (a short notice only of whose memoir I have seen) that no effect *of any consequence* is produced *where organic matters are carefully removed by boiling water and polishing;* for such is perhaps the philosopher's opinion just named, and in as far as our opinions agree, he has the priority. Begun by a purely catalytic action, it is only continued and developed in any *marvellous* degree when those circumstances are present that permit it to assume a more strictly chemical character.

* A permanent spectrum has been proved (see experiments) to be but a higher degree of an evanescent one.

* In coming to this conclusion I have not forgotten another difficulty, viz., why a well *polished* and boiled copper coin produces a spectrum on copper plate. The effect, even when continued an hour or two at a heat of 160°, is *very* slight, and I found it to disappear entirely by twice breathing on the plate. *Contact*, then, of the same metal SLIGHTLY modifies chemical properties: such on the present view is the inference to be drawn from this fact.

SIMPLE WIRE-GAUGE.

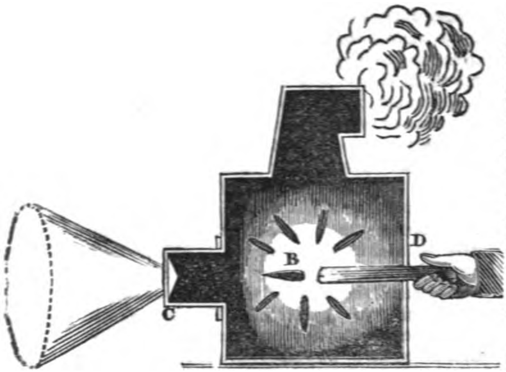


Dear Sir,—I beg to submit to the judgment of your readers the prefixed design of a wire-gauge; if necessary, both sides of the frame might be graduated. (The sketch is not drawn to a scale.) P, represents the parallel scale pointer: W, wire to be gauged; H, hole to hang the gauge up by when not in use. If there are any defects in this plan I shall be glad to have them pointed out.

I remain, faithfully yours,
ARTHUR TREVELYAN.

40, Broughton-street, Edinburgh,
April 18, 1843.

NEW METHOD OF PRODUCING A MOST BEAUTIFUL ARTIFICIAL RAINBOW FOR THEATRICAL AND OTHER EXHIBITIONS.



Sir,—I herewith send you a drawing and description of a new contrivance of mine for producing a prismatic rainbow of undeniable beauty and accuracy, and which will be found of great utility for theatrical exhibitions, when "heaven's aerial bow" is desired to be shown.

A box is first made of wood or tin-plate, and of the form represented in the accompanying drawing. It is like a magic lantern, with this difference, that in the former neither lamp nor magnifying glasses are used, as in the latter. At C there is what may be termed a *prismatic lens:* it is a cone formed of flint-glass, made perfectly "true," and highly polished, and is fitted in the position shown in the figure. At D a circular hole is cut, so as to allow a portfire of brilliant-burning composition, B, to pass freely through; the latter ought to be of about ¾ of an inch in diameter. The portfire is first inflamed at the end B, and then pushed into the lantern; one of the size just mentioned will even give a greater illumination than an ordinary oxy-hydrogen light.

By the action of the lens C the light is decomposed into its component colours, which, when thrown on a flat surface, appear in all their distinct yet blended beauty. A circular-shaped spectrum will, of course, be formed; but half of it can be very easily concealed by placing the apparatus behind the cut scenery representing the hills, trees, &c., so as to cause the bow to be seen on the sky portion of the picture alone—one half of it being thereby below the horizon, and hid from the spectator's view.

I have ofttimes thought that illumination portfires might also be used with some success in the magic lantern, screen microscope, &c., in lieu of the oxy-hydrogen light apparatus, which is both expensive and cumbersome—large gas-holders, &c., being requisite. Not that I think the latter plan will be effectually superseded in a hurry for large exhibitions, but that mine is more easily, conveniently, and cheaply put into action, and therefore more applicable for showing the objects in a private room: no apparatus for making the gases, nor any kind of instruments for using or collecting the same, being necessary.

The illumination portfires mentioned above are those usually sold at firework-makers, at from a penny to about sixpence each; one of a medium length will burn a sufficient time to show a single figure or object on the screen, and that with a most beautiful distinctness.

Sir, I am your very obedient servant,

Z. ROCKLIKE.

Newcastle-on-Tyne,
January 30, 1843.

COWELL'S PATENT TAPS.

Sir,—There are not many articles in daily use which cause so much and such varied annoyance, by their defectiveness, as taps.

The ordinary plug-tap is produced by turning, and made as accurate as practicable by grinding. If the grinding could be stopped when a satisfactory degree of accuracy had been attained, all might be well; but the fact is, that the very act of using the tap is but a continuation of *the grinding process*, which, being carried too far, is soon evidenced by leakage.

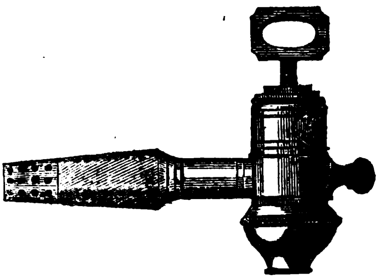
This mischievous effect has been attempted to be got over by resorting to tightening nuts, springs, and a host of other complicated contrivances; and expensive taps have thus been produced, which experience has shown to be little, if any thing, better, in point of durability and trustworthiness, than those of the older and simpler kind.

Repeated failures had invested this object with a most discouraging degree of hopelessness; the end in view has, however, at length been attained, and most successfully, by a very ingenious and

simple tap invented and patented by Mr. Cowell, a gentleman already well known by his very admirable, but imperfectly appreciated, "*sash-suspender*," described in one of your earlier volumes.

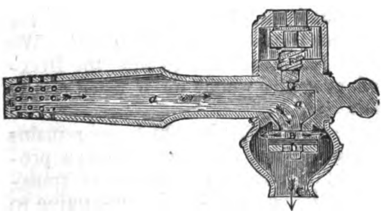
Fig. 1 is a side view of one of Mr. Cowell's patent beer-taps; fig. 2 being a vertical cross section, and fig. 3 a side section of the same. The fluid enters

Fig. 1.



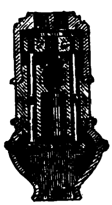
the tap at A, (fig. 3,) as usual, and flows along the passages *a a*, from whence it can only escape by an outlet B, which is closed by a platform D, having a flexible washer on its upper surface.

Fig. 2.



This platform is supported from an upper cross-head by two rods or links, E E, (fig. 2,) which slide vertically through perforations in the solid head of

Fig. 3.



the tap, and are moved up or down with the cross-head, by turning the male screw F. This screw works in a female socket in the solid head of the tap, above the aperture through which the fluid passes. On turning the screw in the one direction, the cross-head, links, and platform are depressed, which opens the aperture B, and allows the fluid to escape out through the nosel C. On reversing the screw, the platform D rises, and the metal round the orifice B, bedding upon the washer, makes a perfectly close joint.

The striking and important difference between the patent tap of Mr. Cowell and all previous contrivances for the like purpose consists in the action, or working parts of the former being altogether distinct and separate from the passage through which the fluid runs; no wear, therefore, however great, can affect the soundness of these taps, and, as the outlet is closed by screw pressure, they can never corrode or set fast. Another important advantage peculiar to Cowell's patent tap is, that, as the knob, or part which is struck when being driven into a barrel, is on a solid metal body, clear of the working parts, the latter remains uninjured, whatever number of blows may be given to the tap. The manufacturers of these taps, (Messrs. Stock and Sharp, of Birmingham,) have done ample justice to Mr. Cowell's ingenious invention, and at his suggestion they have adopted a woven fabric for the washers, in preference to leather; in boiler taps, and in other cases where great heat is present, this is highly important. The expansion by heat, which often operates so injuriously on other metal taps, produces no effect whatever on the patent tap, which continues both steam and water tight at all temperatures, and under all pressures.

If this tap has not realized absolute perfection, it has at least approximated so closely thereto, as to be sufficient for all practical purposes; and not the least of its merits is, that it is offered to the public at as reasonable a price as its imperfect predecessors.

I remain, Sir,

Yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington,
March 7, 1848.

PROGRESS OF SCREW-PROPELLING.

In our last notice on this subject (No. 1028, p. 336), the speed realized by the Government experimental steamer *Bee*, with Smith's propeller attached, in the trial in Long Reach, was stated by

mistake to be 7·358 miles, instead of 6·852 (Mr. Galloway's figures), which gave an apparent superiority to the Smith propeller, over *both* Blaxland's and Ericsson's. We have been since favoured with an inspection of the official reports to the Admiralty of the experiments made with these rival submarine propellers, and extract from them the following authentic particulars:—

Speed in miles per hour.		Weight of the propeller. cwt.	qr.	lb.
With common paddle-wheel	7·7	0	0	0
— Blaxland's screw	7·115	0	2	3
— Smith's „	6·8	2	0	7
— Ericsson's „	5·47	3	0	11

From this comparative statement it will be seen that Blaxland's screw not only gave the greatest speed with the least weight of material, but a speed which, all things considered, must be regarded as surpassing that of the paddle wheel. For though the trials were made under precisely the same circumstances, so far as the three screw-propellers were concerned, they had the following disadvantages in common, as compared with the paddle-wheel; namely, that they had to obtain their power from machinery which was made to be applied to side-propellers only, and could not be adapted, without a certain loss of effect, to give motion to stern-propellers, and that while the screws were at work the vessel continued encumbered with the bulk and weight of the paddle-wheels, which were reefed only for the occasion (so to speak), not unshipped. The Blaxland propeller, therefore, having accomplished 7·115 miles, under such serious drawbacks, must be allowed to have done much more than the paddle-wheel, when it gave, with every circumstance in its favour—vessel and machinery both specially adapted to it—7·7 miles.

Of the *Mermaid*, and Mr. Rennie's conoidal propeller, we have heard nothing farther than what is stated in the following paragraph, which we take, in a slightly abridged form, from the newspapers:—

"*The 'Mermaid' and her Screw Propeller.*—On Tuesday se'nnight the Lords Commissioners of the Admiralty, attended by a numerous party of scientific gentlemen, met at Blackwall, and proceeded in the *Mermaid*, at a rapid rate to Woolwich, where her Majesty's steam-frigates, the *Cyclops* and *Dee* were waiting to receive them; their lordships then went on board the *Cyclops*, which immediately got under way, the *Dee* having preceded her a short time. After the *Cyclops* had advanced some distance, the *Mermaid* was ordered to try her powers, when she immediately quickened her speed, came forward, and rounded the *Cyclops* with the greatest facility: she then continued down the river, passing the *Dee* in the same manner, and leaving the *Cyclops* two miles astern before she arrived at Northfleet. The *Mermaid* then turned back, and performed the measured mile at the rate, we are assured, of *above thirteen miles through the water per hour*. Some of their lordships then returned to London in the *Cyclops*; the remainder of the party proceeded on an official visit to Sheerness Dockyard, in the *Mermaid*. At a quarter past five they started again in the *Mermaid*, and reached the Brunswick-wharf, Blackwall, at eight o'clock, thus accomplishing the distance of 45 miles in two hours and three quarters."

It is but fair to Mr. Blaxland, Mr. Smith, and Captain Ericcson to observe that the efficiency of their respective propellers, as compared with Mr. Rennie's, is not to be judged of by the difference between the rates of speed which they realized when applied to the *Bee*, (7·115, 6·8, and 5·47 miles,) and those obtained by screw power in the *Mermaid*. In the same way that paddle-wheels, when applied to vessels of greater tonnage, better lines, and better engined than the *Bee*, have produced double the speed which was realized in the experiments made with that vessel in Long Reach, so may any of the propellers referred to, prove doubly effective when applied to a vessel made like the *Mermaid*, expressly for stern and sub-marine propulsion. We should like much to see what the Blaxland propeller would do if fitted to the *Mermaid*.

The chief difficulty which now remains to be overcome, in regard to screw propelling, relates to the means of transferring the power of the steam-engine to the propellers. In the *Mermaid*, Mr. Rennie first tried what could be accomplished by simple adhesion, as in the case of railways, but the result was an utter failure. Cog-wheel gearing was next had recourse to, and it is by means of this, the 12¼ and 13 miles an hour have been realized, but the noise and vibration attending the use of it are stated to be something "prodigious." Mr. Blaxland's band system of connexion is free from these objections, but then it is open to the no less serious one of extreme liability (as bands are now ordinarily made) to rapid wear, and sudden disruption. As we observed, however on a former occasion, (in effect if not in words,) we cannot bring ourselves to look on the production of a perfectly efficient band, as out of the range of mechanical possibility. We hold that

it is only necessary that it should be generally known that such a thing is wanted, in order to have the want of it speedily supplied.

We extract from the *Liverpool Standard* the following notice of something doing in the screw way on the Mersey, but we must confess that we are unable to collect from it, with sufficient distinctness, what the advantages are which Messrs. Mather, Dixon, and Grantham's propeller possesses over others.

" *The Liverpool Screw.*"

" A small iron steam vessel has for some time been causing considerable interest on the river, and may be considered a subject of great public importance from the improvement which it exhibits over the present mode of applying steam power for the propulsion of vessels. * * * * *

" It will be very generally known that the screw propeller has for some time excited considerable attention, from its causing the removal of paddle-wheels and boxes; but it has made but little progress in actual practice from two causes—one being the supposition that it could never be made so efficient in propelling as the paddle-wheel—and the other that, to obtain sufficient velocity it was necessary that it should make more revolutions than the engines which worked it, requiring the intervention of spur wheels, or straps and pulleys. This small steam-vessel, which was built by Messrs. Mather, Dixon and Grantham, of this town, however, proves very clearly that such doubts are fallacious. The engines are applied direct to the shaft to which the screw is attached, and no spur wheels are required to obtain the necessary speed; and the makers have assured us that this principle can be carried out in the largest vessels without employing any means that practice has not already successfully established in the use of paddles on the old system. That high velocities can be attained is shown by this vessel, which has now beaten every steamer on the Mersey, and this with an expenditure of fuel not much exceeding one cwt. per hour.

" Another proof of the value of these improvements is shown in the fact, that the relative speed of the vessel and the screw are as 93 to 100, while with the paddle-wheel the proportion is generally as 70 to 100, showing a saving of upwards of 20 per cent., or, in other words, that an engine of 80 horses' power, with a screw, will drive a vessel as fast in smooth water as one of 100 horses', with paddle-wheels.

" The screw employed was patented by Mr. Woodcroft, of Manchester, several years since, but has not been generally known, although, from the results, it has evidently great value. The pitch of the screw is not uniform, as usually made, but expands or increases in the length of the pitch, the object being, that as the water receives motion by the first impact of the screw, the blade of the screw should follow it up with greater rapidity.

* * * * *

" The vessel is 65 feet between the perpendiculars, and 12 feet 6 inches beam; her average draft of water when ready for work is 3 feet 9 inches; she is worked by two cylinders 13 inches diameter, and 18 inches stroke, and, when light, averages about 85 revolutions per minute. The boiler is on the locomotive principle, and the usual pressure of the steam 50 lbs. per square inch, and is sometimes increased to 56 lbs. Expansion valves are always used, which cut off the steam at one-fourth of the stroke—thus by making allowance for the pressure of the blast pipe, and for the operation of the expansion, which wire-draws the steam at closing, the actual power is equal only to a boiler pressure of from 27 lbs. to 30 lbs. per square inch.

" In comparing this with the nominal horse-power of the vessels against which she has been running, which generally have a pressure of 7lbs. per square inch on the boiler, and 13lbs. in the condenser, (equal to a boiler pressure of 20lbs.) and the piston working 200 feet per minute, makes the power employed in the screw vessel from 19 to 21 horses.

" We may add a few particulars of a trip made by her on Friday last, which was taken in order to test her power of towing. She was matched against the Bridgewater, one of the best tow-boats on the river for her power. The 'Screw' had five flats, and the 'Bridgewater' seven.

" The nominal power of the former is 20, and of the latter is 34 horses. With these respective loads the screw-boat occupied 1 hour and 47 minutes from the Duke's Dock to the dock at Runcorn, beating the Bridgewater a few minutes—showing a superiority in the screw of about 25 per cent. in proportion to the nominal horse-power. But it has since been found from actual measurement that the respective power was as 163 to 300, showing a still greater advantage in favour of the screw.

" The little vessel, in a short time after her arrival at Runcorn, started for Weston Point. In the canals it is found that the screw has not the least effect on the banks, and that the disturbance in the water is no more than if the same vessel was tracked by

horses. At Weston Point, the canal being deep, the steamer could make more speed than is usually thought advisable in other places. She, however, took a flat in tow for nearly half the distance; and with this incumbrance, and the engine working slowly, she performed four miles in 36 minutes. An engineer belonging to the navigation accompanied her, and expressed himself satisfied that no injury to the banks could be caused by her.

"She then proceeded at full speed up the winding and beautiful River (Weaver,) and arrived, after a most delightful sail, at Northwich. Here she took on board a large party, and proceeded to Winsford, but, owing to the numerous narrow turns in the river, her speed could not be maintained. The next morning she returned to Weston Point, running the distance from Northwich in 2 hours and 25 minutes, including the delays in the locks.

"From this she started for Liverpool, the wind blowing very strongly against her, and the river very rough. Shortly after starting she overtook the Alice tow-boat, of 70 horse-power, with three flats in tow, one heavy and two light. Our little vessel took the loaded flat in tow, and now commenced a struggle. The short and angry sea continually breaking over the flats, and almost hiding them from the crew of the steamers; and here, more than ever, the triumphant superiority of the screw was shown. In spite of the disturbed state of the water and the plunging of the vessels, it maintained its usual uniform speed, and soon left the Alice in the distance. On reaching Liverpool she again proceeded on her way and ran down the channel for some miles, but, as the tide was falling, the water became smooth, and she, therefore, returned to her moorings.

"When she left the Duke's Dock on Friday, she had 18 cwt. of coke and 4 cwt. of coal on board; to this was added 11½ cwt. of coke at Northwich; and with this fuel she performed all the work above described, and when she came to an anchor at 3½ p. m. on Saturday, she had about 7 cwt. remaining. The steam was up from 7 a. m. on Friday, till 8½ p. m. The fires were kept up all night, and at 6 a. m. on Saturday she again got up steam, and continued till 3½ p. m. The quantity of fuel consumed was consequently very small.

"Thus, under all the circumstances by which a steamer can be tested, (say our informants,) has this little vessel proved the advantage of the principle on which her machinery is constructed."

EXTENSION OF PATENT RIGHT.

Judicial Committee of the Privy Council—May 13.

Petition of Lucena, assignee of patent granted to Elijah Galloway, for paddle-wheels (commonly known as Morgan's).

The SOLICITOR GENERAL and Mr. BUTT supported the petition; Mr. M. D. HILL and Mr. RICHARDS opposed it.

This was an application for the extension of a patent, granted in 1829, for the well-known paddle-wheel, known as "Morgan's wheel," (see *Mech. Mag.*, vol. xxii. No. 598.) From Mr. BUTT's statements it appeared that two patents (one for England, and the other for Scotland) had been granted to Elijah Galloway, in 1829, which were immediately after assigned by him to Mr. Wm. Morgan, who subsequently became a partner in the late firm of Acraman, Morgan, and Co., of Bristol, and was involved in their failure last year; having, however, some years previously—namely, in 1831, assigned one-fourth of his interest in the patent to Mr. Lucena, the petitioner, for 4,000*l.*, and mortgaged the remainder, with some other securities, for 4,500*l.* In 1832, Mr. Morgan having become bankrupt, the whole title to the patent, by various mesne assignments, became vested in the petitioner. Up to 1835, the patent had only been applied to the *Columbian*, *Firebrand*, and other Government steamers. In that year the patent was infringed, in consequence of which proceedings ensued both at law and in equity, which did not terminate until 1839, and which entailed a loss of nearly 3000*l.* on the petitioner. Mr. Morgan (who had the sole license) fitted up several vessels, principally for the Government, with the exception of some foreign vessels; but the patent had not been brought into general and public use, and the profits, therefore, which Mr. Lucena, the assignee, had derived from the invention, were very small, whilst he had sustained a loss of from 7000*l.* to 8000*l.* The public were, however, beginning to appreciate its value, and it was about to be applied to the royal steam yacht, *Victoria and Albert*, now building.

Lords BROUGHAM and CAMPBELL expressed their surprise that, if its advantages were so great, the public should have been so slow in using it, for it appeared that none of the great steamers—the Atlantic steamers, for instance, which were fitted up without regard to expense—had adopted this paddle-wheel.

Mr. BUTT said it had been suggested that there was some difficulty in keeping it in repair, in consequence of the frame being more complicated.

Lord Brougham: That must be very dangerous upon a long voyage. Steamers, when they get out of order, are the worst of all sea-boats. I know a very great sailor—one of the greatest seamen, perhaps, of the present time—who said to me that he would not cross the Atlantic in the *Great Western*, if they were to give her to him, so dangerous did he think steamers were as sea-boats at sea; certainly, not on a lee shore.*

Mr. Butt said that the invention had been applied to several Government steamers, and had answered remarkably well, for several years, even in the most boisterous weather, there being no difficulty at all in keeping them in repair; and the advantages over the common radial wheel were proved to be very great indeed. The increased speed, independently of that advantage in itself, would, of course, cause a diminution in the consumption of fuel: there was also much less vibration, which was a very important improvement.

Witnesses were then called in support of the allegations of the petitioner.

Mr. Cottam, engineer, explained the advantages of the wheel over the common radial wheel, by models.

Captain Kennedy stated that he had commanded the *Spitfire*, a Government steamer, which had Morgan's paddles, for four years. Their speed was increased about a knot and a half per hour, and the motion arising from the working of the wheel was so trifling that any one could write close by it. He had been out in two hurricanes, one of them of the most terrific character, when four vessels near him were lost; and he believed himself and crew owed their safety to Morgan's paddle-wheel. It had been disliked in consequence of the bushes, which the spindles worked in, giving way very often; but he was confident that if they had been made of soft instead of hard metal, they would have answered very well. The great objection had been that the bushes had been brittle; but when they had broken, he had used the common boiler plate-iron, and that, being soft, was almost better after twelve months' wear than before.

John Boswell, engineer of her Majesty's ship *Hydra*, which vessel was fitted with Morgan's paddles, spoke of her efficiency when with the squadron off St. Jean d'Acre, Beyrout, &c. At the latter place, she got out of the bay, for shelter, in a gale of wind, when no other steamer could do so.

Some other witnesses having been examined, Mr. Hill addressed the Court against the petition, urging—first, that the moveable float, as in Morgan's wheel, was not a new invention, but had been long known; secondly, that moveable floats entering the water at any given angle was the discovery of M. Cavé, a Frenchman, who had invented a paddle-wheel, in 1828, on the same principle as that of Morgan's, but worked by more simple and durable mechanism, the short axis of Morgan's wheel being, as he should show, dangerous, in consequence of the great strain upon the machinery. M. Cavé's wheel had been adopted by the French Government, and was admitted by scientific men to be in every respect the best which had ever been invented. A third ground of opposition arose from the fact of the invention, up to the present day, having been worked upon other improvements, which were not the subject matter of the patent, and which the public ought not to be deprived of any longer than was absolutely necessary. Lastly, with respect to steam navigation, which was of infinite importance in a national point of view, the French, our great rivals, had the advantage of the improved invention, and their lordships would surely not throw, for a longer period, into the hands of those who had hitherto made nothing of it, a monopoly, which might prevent our keeping pace with France, merely for the purpose of private aggrandisement.

Mr. Farey, and another gentleman, then explained, by models, the inventions of Buchanan, Oldham, and Cavé; and pointed out what they considered to be the disadvantages of Morgan's wheel, the angles of which were precisely the same as those of Cavé's; but the machinery was more complicated, and they considered it dangerous in long voyages, in consequence of the strain upon it, which certainly lessened its power of resisting the action of the sea. The French Government steamers—and, in fact, the steamers generally in France—were worked by Cavé's wheels, a great number of which were manufactured in this country.

The Solicitor-General addressed their lordships in reply, at the conclusion of which, after a short deliberation,

Lord Brougham gave judgment, by which their lordships decided to extend the patent five years, as they considered the invention a most valuable one, and that no benefit whatever appeared to have been derived by the petitioner from it. His Lordship remarked particularly upon the fact of the unpleasant noise and vibrating motion, caused by the radial wheel, having been smoothed away by Morgan's paddle, and stated that their lordships hoped it would be better patronized by the public.

* These opinions have produced a letter from Mr. Claxton, the agent for the *Great Western*, the substance of which we give in a subsequent page.—Ed. M. M.

LORD BROUGHAM AND THE DANGERS OF STEAM NAVIGATION.

In consequence of the startling opinions expressed on this subject by Lord Brougham, at the hearing of the application for an extension of the patent for Morgan's paddle-wheel, (see preceding page,) Lieutenant Claxton, the managing director of the Great Western Steam Company, has published a very clever and satisfactory reply to his lordship.

The following are the principal paragraphs:—

"I shall, in the remarks I am about to make, and which I should not have made at all had not 'one of the greatest seamen, perhaps, of the present time' been brought forward as authority, assume that the observation was hazarded in the infancy of our undertaking, at the time when most naval officers of my acquaintance predicted that the *Great Western* must either break her back, be swallowed up in the trough of the sea, or dive under the powerful swells of the Atlantic, if we attempted to force her against them. It is probable, my Lord, that the 'great sailor' you allude to made the observation either at or about this period, or when the *President*, a weak and under-powered ship, became missing. If, my Lord, such should be the opinion of the 'great sailor' at the present day, your Lordship will, although only a landsman, upon the strength of the information, and armed with the facts I am about to produce, be able to refute a host of nautical arguments by one homely observation, to wit, 'the proof of the pudding is in the eating.'

"I could furnish many instances of steamers surviving gales in which the best found sailing ships must have gone on shore, but for brevity shall content myself with the two which are mentioned in the very same report of the proceedings before the Privy Council, and an extraordinary recent case out of the very many from which the *Great Western* has been able to extricate herself, and all the valuable lives of passengers and crew, with comparative ease.

The case of the *Spitfire* was simply this—she steamed from off a lee shore in the height of a hurricane, when most, if not all, the ships in Carlisle-bay, Barbadoes, were forced high and dry from their anchors or moorings. The case of the *Hydra*, if I mistake not, was one of steaming to sea when one of Her Majesty's men-of-war cut away all her masts with three anchors ahead. If not the *Hydra*, some other steamer at or near Beyrout, and the *Hydra's* is only another instance.

"The *Great Western*, on her last homeward voyage, was caught in the very bight of the bay formed by Long Island, and the Jersey coast, within an hour and a half's sail of the bar at Sandy Hook, with the wind at S. E., or dead on shore, it blew a furious hurricane for 12 hours (so hard that one of her boats, rather slighter built than the rest, unstruck by a sea, was shivered to atoms in the slings,) the whole time in only 15 fathoms of water, and according to the Captain's report when no canvass could have stood a minute, and yet, my Lord, instead of nearing the shore she increased her distance from it. The American papers teemed with the losses in this really terrific gale, and great fears were openly expressed for the safety of our gallant ship.

"The *Great Western*, and all the noble ships of the Halifax line, have experienced quite as bad weather in six years, with constant passages at stated periods, as the Atlantic is or, probably, ever before has been subject to, and the former ship alone has travelled considerably over 200,000 miles with no other accident than the loss of a bowsprit in coming up like a whale to blow, after a rather deeper plunge than usual with fair head way, on her right course, my Lord, and against a head wind and sea.

"The late Sir Thomas Hardy, my esteemed and lamented friend, had none of the prejudices against steam ships which for a time obtained so generally in the navy, and he approved of almost every step that was taken in the progress of the *Great Western*. Had it pleased God to lengthen his life, he would have been the champion of our cause in the present day. A seaman of the very first calibre, he would have been a noble champion to break a lance with your Lordship's 'great sailor;' lacking such an one, if he would enter the lists with Captain Hosken, or even my humble self, I think we should be able to prove that the steam-engine with its appurtenances (to say nothing of other advantages) renders a ship safer in bad weather, whether scudding before the wind or crawling off a lee shore, than a craft only propellable when the wind pleases to blow, and whose safety depends upon canvass, which the steam ship, like herself, has also at command and in sufficient quantity for violent weather; and your Lordship may rely upon it that the steam ship, which can for 12 hours make head against a hurricane, when there would not have been two hours drift for any sailing ship in the world, would not do very badly in an ocean tempest of whatever strength or duration."

THE HOT BLAST PATENT.

Our readers will recollect that in the Scotch case of Neilson and others *against* Bairds, the House of Lords set aside the verdict in favour of the Plaintiffs on the ground of mis-direction by the presiding Judge. A second writ has accordingly taken place, of which the following account is given in the *Scotch Reformers' Gazette*, of Saturday last.—Ed. M. M.

After a long trial of ten days, unprecedented, we believe, in the annals of the jury court of Scotland, a verdict was returned in favour of the pursuers at six o'clock this evening, the leading particulars of which will be found subjoined:—

The pursuers were Mr. James Beaumont Neilson, of Glasgow, engineer; Charles M'Intosh, formerly of Cross Basket, now of Campsie; John Wilson, formerly manager of the Clyde iron-works, now of Dundyvan, for themselves; and James Oswald, of Shield Hall, now one of the members of parliament for the city of Glasgow; James Dunlop, jun., merchant, of London, brother-german of Colin Dunlop, after designed; Andrew Bannatyne, writer, in Glasgow; Charles M'Intosh aforesaid; James Dunlop, formerly of Fluyder-street, Westminster, now residing at Clyde ironworks, nephew of the said Colin Dunlop; and John Wilson aforesaid, as trust-disponees of Colin Dunlop, formerly of Clyde ironworks, thereafter of Tollcross, now deceased; and Messrs. William Baird, Alexander Baird, James Baird, Douglas Baird, and George Baird, carrying on business, in partnership, at Gartsherry ironworks, in the parish of Old Monkland, under the firm of William Baird and Co., were defenders.

The cause of action was infringing on the plaintiff's patent right to use the hot blast; and the profits and other damages, at the date of action, were laid at 20,000*l.*

The case for the pursuers was opened before the Lord President and a special jury, in the first division of the Court of Session, on Wednesday, the 10th current.

The Dean of the Faculty of Advocates (Patrick Robertson, Esq.) detailed the whole circumstances of the case, and the various proceedings in the Court of Session and in the House of Lords. He contended for the validity of the pursuers' patent; he undertook to prove that the defenders, by themselves and others, had invaded or taken advantage of it, whereby they had made great gains or profits, and that they were justly liable to make reparation to the pursuers. He concluded a brilliant speech, which occupied nearly six hours, by calling upon the jury to find accordingly.

Evidence was then given in support of the issues for the pursuers, which occupied the court from Wednesday till Monday following. This evidence consisted of practical and scientific men from all parts of the kingdom. At its conclusion,

The Lord Advocate of Scotland (Duncan M'Neill, Esq.) opened the case for the defenders in a masterly speech of five hours, in which he analysed the evidence of the pursuers, and undertook to prove that the pursuer, Mr. Neilson, was entitled to no credit for his invention, because the hot blast for which he obtained the patent was in use and well known before the date of it; that the patent itself was void in law, and that no damages were exigible by him or by the pursuers from the defenders.

The evidence led by the defenders in support of the defence occupied the court from Tuesday till the afternoon of Friday.

Andrew Rutherford, Esq., (late Lord Advocate of Scotland,) then replied on the evidence, and on the whole case for the pursuers. His speech, which occupied nearly four hours in the delivery, was clear, forcible, and lucid. He called upon the jury to protect his clients, whose legal and just rights had been invaded by the defenders amongst others, and to give exemplary damages under the issues. The court then adjourned till the following day, (Saturday.)

The Lord President having resumed his seat on the bench by half-past twelve o'clock, proceeded to charge the jury in a luminous, straightforward, and able manner. His lordship's address occupied three hours and a half.

The Lord Advocate, on behalf of the defenders, having taken several exceptions to the views of the Lord President, the jury retired at half-past four, and at six o'clock returned in effect the following verdict:—Unanimously finding in favour of the pursuers in all the issues; awarding 7,000*l.* damages, and 4,867*l.* 16*s.* for profits, making, in all, 11,867*l.* 16*s.*; the 4,867*l.* 16*s.* for profits, being on 4,393 tons, manufactured within six weeks, the period specified in the present action.

ELECTRIC COLUMNS.

[From Report in *Midland County Herald*, of proceedings of the Birmingham Philosophical Institution.]

Mr. George Shaw made some remarks on the electric columns of De Luc and Zamboni, which were on the lecture table, as well as an instrument invented by himself for facilitating the production of secondary or induced voltaic currents. Mr. Shaw observed that he had little to say respecting the electric columns, as they possessed little novelty; one of them was remarkable only as being one of the largest instruments of

the kind that had been constructed, (consisting of forty-five thousand layers of zink, manganese, and honey,) and the other was interesting in a theoretical point of view, from a peculiarity in its construction, to which he would presently allude. In describing these instruments, Mr. Shaw said that De Luc's column consisted of discs of zink, silver, and writing paper, piled on each other in regular succession to the extent of several thousands; and that Zamboni's pile was thus made—thin plates of zink were pasted on sheets of writing paper, the paper was several times washed with a dilute solution of honey in water, until the paper was thoroughly saturated, and fine powder of peroxide of manganese was laid on the surface of the paper; by means of a punch, the material thus prepared was cut into discs, which were piled in tubes of glass well varnished within and without. The phenomena exhibited by these instruments were remarkable; if their extremes were brought into contact with gold leaf electroscopes, divergence of the leaves was produced, indicating an electric excitement. In the large instrument on the table, the electric excitement was so strong, that by bringing wires connected with them within one-eighth of an inch of each other, bright sparks passed between them. These instruments exhibited these phenomena during upwards of twenty years or more. Mr. Shaw also discussed the theory of these instruments, and contrasted them with the voltaic pile; the chemical phenomena of the pile were noticed, and the question whether or not the same chemical changes were taking place in the electric column examined at some length. Mr. Shaw also alluded to an extensive series of experiments he had made on these instruments, and called particular attention to one of the instruments on the table; that instrument was a De Luc's column, constructed under the following circumstances:—The discs, during the time they were being piled in the glass tubes, were heated to such a temperature that it was with difficulty the hands could touch them; the tubes too were similarly heated; and after the discs had been put in the tubes, the whole was sealed up perfectly air tight. The instrument had been heated, and suddenly cooled nearly to zero of Fahrenheit's thermometer in order to determine the presence of water by its condensation on the interior surface of the glass tube. No such condensation was observed. Mr. Shaw dwelt on the theoretical bearing of these experiments at some length, and next briefly described an instrument for rapidly establishing and breaking battery contact, in the induction of secondary voltaic currents. The phenomena of volta-electric induction were noticed, and the importance of a means of regularly establishing and interrupting the primary current pointed out. Mr. Shaw said, that, when experimenting on this subject, it had been his good fortune to discover a means of doing so effectually, and the instrument he had constructed for the purpose was now before them.

LIST OF WORKS ON THE ARTS AND SCIENCES, PUBLISHED IN MAY.

On the Nature of Thunder Storms, and on the Means of Protecting Buildings and Shipping against the Destructive Effects of Lightning. By W. Snow Harris, F.R.S. 8vo., with illustrations.

The Spirit of Mathematical Analysis, and its relation to a Logical System. By Dr. Martin Ohm, of Berlin. Translated from the German by Alexander John Ellis, B.A. 4s.

The Revenue in Jeopardy from Spurious Chemistry. By Andrew Ure, M.D., F.R.S., &c. 1s.

Rules in Plain and Spherical Trigonometry; with numerous Examples and Problems. By H. W. Jeans, F.R.A.S., Royal Naval College, Portsmouth; formerly Mathematical Master in the Royal Military Academy, Woolwich. 3s. 6d.

Solutions of the Astronomical and other Problems in the preceding volume; designed as an Introduction to Nautical Astronomy. 12mo., 3s. 6d. cloth.

Arts, Antiquities, and Chronology of Ancient Egypt, from Personal Observations. By G. H. Wathen, Architect. Royal 8vo., with numerous Plates and Woodcuts. 16s.

Description of Whitelaw and Stirrat's Patent Water-mill; with an Account of the Performances of a number of these Machines. To which is added, Information on Water Power, and other subjects related to the above. By James Whitelaw. 64 pp. 8vo. With seven plates. 2nd edition, greatly enlarged. London and Edinburgh, 1843. 2s. 6d.

Periodicals devoted to the Arts and Sciences.

The London, Edinburgh, and Dublin Philosophical Magazine, (being a continuation of Tilloch's Philosophical Magazine, Nicholson's Journal, and Thomson's Annals of Philosophy.) By Sir David Brewster, Richard Taylor, F.S.A., Richard Phillips, F.R.S., and Robert Kane, M.D. Third Series. No. 146. 2s. 6d.

The Edinburgh New Philosophical Journal, conducted by Professor Jamieson. No. 69. 7s. 6d.

The Civil Engineer and Architect's Journal. No. 68. 1s. 6d.

Annals of Chemistry and Practical Pharmacy. No. 18.

The Illustrated Polytechnic Review. Nos. 9 to 11.

The Pharmaceutical Journal and Transactions. Edited by Jacob Bell. No. 23. 1s.

The London Journal, (Newton's). No. 137. 2s. 6d.

The Artizan. No. 4. 1s.

The Repertory of Patent Inventions. Enlarged Series. No. 5. 3s.

The Practical Mechanic and Engineer's Magazine, (Glasgow). Part 20. 8d.

The Builder. Nos. 8 to 11.

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 29TH OF APRIL, AND THE 27TH OF MAY, 1843.

James Stewart, of 3, Gloucester Crescent, Saint Pancras, pianoforte-maker, and Thomas Lambert, of 91, Albany-street, Saint Pancras, pianoforte-maker, for improvements in the action of piano-fortes. April 29; six months.

Moses Poole, of Lincoln's Inn, gentleman, for

improvements in making decoctions of coffee and other matters. (Being a communication.) April 29; six months.

James Hesford, of Great Bolton, Lancaster, mill-wright, for improvements in the manufacture of certain bowls and rolls. May 2; six months.

Josiah Longmore, of Regent-street, Kennington, silversmith, for certain improvements in pens, pen-holders, and pencil cases, part of which improvements are applicable to other useful purposes. May 4; six months.

Edward Morewood, of Thornbridge, Derby, merchant, and George Rogers, of Chelsea, gentleman, for improved processes for coating metals. May 4; six months.

Francis Daniell, of Camborne, Cornwall, assay master and analytical chemist, and Thomas Hutchinson, of Rosewarne, in the same county, esquire, for certain methods of obtaining or manufacturing lime from a substance or substances not hitherto made use of for that purpose. May 4; six months.

John Turnbull, of Holywell Mount, Shoreditch, card-maker, for improvements in the manufacture of horse-shoes. May 6; six months.

James Roose, of Wednesbury, Stafford, for an improvement or improvements in the mode or method of manufacturing welded iron tubes. May 9; two months.

William Edward Newton, of Chancery-lane, civil engineer, for certain improvements in the construction of boxes for the axles or axletrees of locomotive engines and carriages, and for the bearings or journals of machinery in general, and also improvements in oiling or lubricating the same. (Being a communication.) May 15; six months.

John Tappan, of Fitzroy-square, gentleman, for certain improvements in machinery for preparing and spinning hemp and such other fibrous materials as the same is applicable to. (Being a communication.) May 15; six months.

Robert Alexander Kennedy, of Manchester, cotton-spinner, for certain improvements in machinery for grinding and sharpening cards used in carding cotton or other fibrous material. May 15; six months.

John Lucena Ross Kettle, of Upper Seymour-street, Portman-square, esquire, and William Prosser, junior, of Shaftsbury-terrace, Pimlico, gentleman, for improvements in the construction of roads, and in carriages to run thereon. May 16; six months.

Joseph Burch, of the City-road, engineer and machinist, for certain improvements in machinery for printing on cotton, silk, woollen, paper, oil-cloth, and other fabrics and materials, and certain apparatus to be used in preparing the moulds and casting surfaces for printing, and for certain modes of preparing surfaces previous to the design being delineated upon them. May 16; six months.

William Mills, of Foster-lane, glove-manufacturer, for improvements in fastenings for gloves and other wearing apparel, and in the mode of attaching the same. May 16; six months.

John Thompson, of Albury, near Guilford, doctor of medicine, for certain improvements in bedsteads and couches for invalids. May 16; six months.

Joseph Mazzini, of King's-road, Chelsea, gentleman, for improvements in typographical printing, combining the advantages of moveable types with the stereotype process by substituting for distribution, a special font for each new work, by means of a pneumatic machine for casting, and a uniplane machine for composing. (Being a communication.) May 16; six months.

John Winter Walter, of Stoke under Ham, Somerset, glove manufacturer, for improvements in the manufacture of gloves. May 16: six months.

Robert Walker, Junr., of Glasgow, merchant, for certain improvements in propelling ships and boats. May 18; six months.

Charles Maurice Elizee Sautter, of Austin-friars, London, gentleman, for improvements in the manufacture of borax. May 22; six months.

Christopher Nickels, of York-road, Lambeth, gentleman, for improvements in the manufacture of fabrics made by lace machinery. May 22; six months.

Alfred Poole, of Mornington-place, Camberwell, New-road, for improvements in drying malt and grain. May 25; six months.

Moses Poole, of Lincoln's Inn, gentleman, for improvements in the deposition of certain metals, and in apparatus connected therewith. (Being a communication.) May 25; six months.

John Gillett, of Brailso, Warwick, farmer, for an improved machine or apparatus for cutting or boring ricks. May 25; six months.

John Bushby Gibson, of Nantwich, Chester, esq., for certain improvements in the manufacture of salt. May 25; six months.

Elijah Galloway, of Seymour-street, Euston-square, civil engineer, for certain improvements in the machinery for propelling ships and other vessels. May 25; six months.

Alexander Bain, of 826 Oxford-street, mechanist, for certain improvements in producing and regulating electric currents, and improvements in electric time-pieces, and in electric printing and signal telegraphs. May 27; six months.

Richard Henry Billiter, of Mase pond, Southwark, oil merchant, for improvements in filtering oils. May 27; two months.

Arthur Hill, of the Slad Parsonage, near Stroud, Gloucester, clerk, for an improved shower bath. May 27; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 26TH OF APRIL TO THE 27TH OF MAY, 1843.

William Edward Newton, of the Office for Patents, 66, Chancery-lane, Middlesex, civil engineer, for certain improvements in the construction of boxes for the axles or axletrees of locomotive engines and carriages, and for the bearings or journals of machinery in general; and also improvements in oiling or lubricating the same. (Being a communication from abroad.) Sealed April 26.

Nicolas Henri Jean Francois Comte de Crouy, of Connaught-terrace, Middlesex, for certain improvements in rotary pumps and rotary steam-engines. April 28.

Hinrick Zander, of North-street, Middlesex, gentleman, for certain improvements in steam-engines, boilers, and furnaces, and in the methods of feeding the same; as also the machinery for applying steam power to propelling purposes. May 2.

Pierre Pelletan, of Bedford-square, Middlesex, esquire, for improvements in the production of light. May 4.

William Mayo, of Lower Clapton, and John Warmington, of Wandsworth-road, gentleman, for improvements in the means of, and apparatus for, manufacturing gaseous liquors, and for filling bottles and other vessels used for holding the same, and retaining the contents therein, and emptying the same when required. (Being a communication from abroad.) May 4.

Isham Baggs, of Wharton-street, Middlesex, chemist, for improvements in the production of light. May 9.

André Eustache Gratien Auguste Maurras, of Cornhill, London, gentleman, for certain improvements in the process and apparatus for filtering water and other liquids; a part of which improvements are his invention, and the remainder communicated to him from a foreigner abroad. May 17.

NOTES AND NOTICES.

Curious Subterranean Effects of the Late Earthquake.—At the last quarterly meeting of the Manchester Geological Society, Thomas Moore, jun., Esq., of Hilcot, near Bolton, made the following remarks upon the effects produced by the late earth-

quake in England. "In the neighbourhood of Shaples, two miles north of Bolton, certain parties are engaged in boring; the upper strata through which they have passed consists of sand, gravel and marl, and, on account of their loose nature of two former substances, seven or eight yards of the hole is piped with a strong tin casement, to keep it open and clear from rubbish. At the depth of 20 yards they entered the rock, which is known to average from 25 to 30 yards in thickness. Into this they had bored about 10 yards on the evening preceding the earthquake. When the men left their work, the whole was secure and safe, and a clear spring of water was flowing from the mouth. But, on their return in the morning, the water had ceased to flow, and furthermore, when they commenced putting the rods down, they found they could not pass. In their endeavours to force them down, the chisel became entangled with the tin casement, and the latter was, consequently withdrawn from the bore-hole. The appearance which it presented was very singular, being completely flattened and slightly bent in various directions,—so effectually was it compressed that, on holding one end to the eye, not a ray of light could be distinguished passing through it. As soon as the tube was withdrawn all the loose sand, gravel, and boulders ran in and completely choked the hole; and although the men have been working every day since the occurrence, they have not yet regained their former depth."

Washing Linen.—The *Presse* has some curious speculations on this subject. All river or spring water holds in solution carbonate of lime, which is decomposed by alkaline soap, and the result is a soap having for its base insoluble lime. This calcareous soap attaches itself to the linen, and the heat of the ironing melts and drives it into the article washed with it. It is to the presence of this calcareous soap that the bad smell of the linen for which it is used is due. When cotton or linen cloth has undergone the process of washing with soap twenty times it becomes impermeable. It is, in fact the secret means employed for rendering all cloths impermeable, not, indeed, by soap washing them twenty times, but by saturating them with a calcareous soap produced by the dissolving of an alkaline soap, which is afterwards decomposed on the stuff by the dissolving of a soluble calcareous salt. But though it may be useful to render a cloth coat impermeable, to save the wearer from being wet by rain, it is contrary to health to wear next to the body that which will not absorb the perspiration. There is, however, a very simple mode of avoiding this inconvenience; it is by putting into each litre of water used for washing one or two grammes of potasse or soda, before dissolving the soap in it. By this the calcareous salt will be precipitated, and the soap, meeting with no lime in the water, will not undergo any decomposition, and consequently no calcareous soap can remain in the linen. The use of soda or potasse will not be at all expensive, because the alkali remains in the water, and contributes with the soap to the cleansing of the linen.

Speaking Machine—(From the letter of a Hamburgh correspondent of the *Athenæum*.)—An invention is, at present, attracting great attention here, and which certainly merits every praise that can be bestowed upon unwearied perseverance and successful ingenuity. It is the *Sprachmaschine*, or the Speaking Machine, not quite appropriately called Euphonia, of Mr. Faber, the result of a beautiful adaptation of mechanics to the laws of acoustics. You are aware that the attempts of Cagniard la Tour, Biot, Müller, Steinle, to produce articulate sounds, or even to imitate the human voice, have not been very successful; in fact, our knowledge of the physiology of the larynx and its appendices has been so limited, that we have not even an explanation of the mode in which the falsetto is produced. Mr. Faber's instrument solves the difficulties. I can only give you a very imperfect idea of the instrument. To understand the mechanism perfectly, it would be necessary to take it to pieces, and the dissection naturally is not shown the visitor—less from a wish to conceal anything, than from the time and labour necessary for such a purpose. The machine consists of a pair of bellows at present only worked by a pedal similar to that of an organ, of a caoutchouc imitation of the larynx, tongue, nostrils, and of a set of keys by which the springs are brought into action. [The further description would be unintelligible without diagrams.] The rapidity of utterance depends, of course, upon the rapidity with which the keys are played, and though my own attempts to make the instrument speak sounded rather ludicrous, Mr. Faber was most successful. There is no doubt that the machinery may be much improved, and more especially that the *timbre* of the voice may be agreeably modified. The weather naturally affects the tension of the Indian rubber, and although Mr. Faber can raise the voice or depress it, and can lay a stress upon a particular syllable or word, still one cannot avoid feeling that there is room for improvement. This is even more evident when the instrument is made to sing; but when we remember what difficulty many people have to regulate their own chordæ vocales, it is not surprising that Mr. Faber has not yet succeeded in giving us an instrumental Catalani or Lablache. Faber is a native of Freiburg, in the Grand Duchy of Baden—he was formerly attached to the Observatory at Vienna, but, owing to an affection of the eyes, was obliged to retire upon a small pension; he then devoted himself to the study of anatomy, and now offers the results of his investigations, and their application to mechanics, to the world of science.

The Gazette des Postes of Frankfort announces that an Englishman, named "Yardley," residing at Manheim, has invented a typo-electro-magnetic telegraph, by which news may be transmitted with the greatest rapidity from one place to another, and which at the same time fixes the impression on paper, in the same manner as by a printing-press and types.

Sails Woven Whole.—Mr. John H. Sadler, at Holbeck, in Leeds, has invented a loom for weaving each sail of a ship, even of the largest class, in one entire piece; and a machine, also, for spinning, doubling, and laying the yarn, either for two-thread or three-thread, for the warp and weft; thereby giving much greater strength to the cloth, with half the weight.

Chinese Notions of English War Steamers.—A curious Chinese drawing of the *Nemesis*, iron war steamer, arrived with the last overland mail; it is a most rude affair, reminding us of the representations of ships two or three centuries ago. On the chimney are the Chinese characters, *Yew-tung* (smoke passage), and on the paddle-box, *Chay-kee* (wheel covering). The following quaint description, in Chinese characters, fills up the corners:—"This war steam-ship is above 300 cubits long, and more than 30 high in the hull. Iron is employed to make it strong. The hull is painted black, weaver's shuttle fashion. On each side is a wheel, which, by the use of coal fire, is made to revolve as fast as a running horse. White cloth sails are used to propel the ship when the wind is favourable. At the vessel's head is a marine god; and at the head, stern, and sides are cannon, which give it a terrific appearance. Steam-vessels are a wonderful invention of foreigners, and are calculated to afford delight to many."

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by W. and A. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

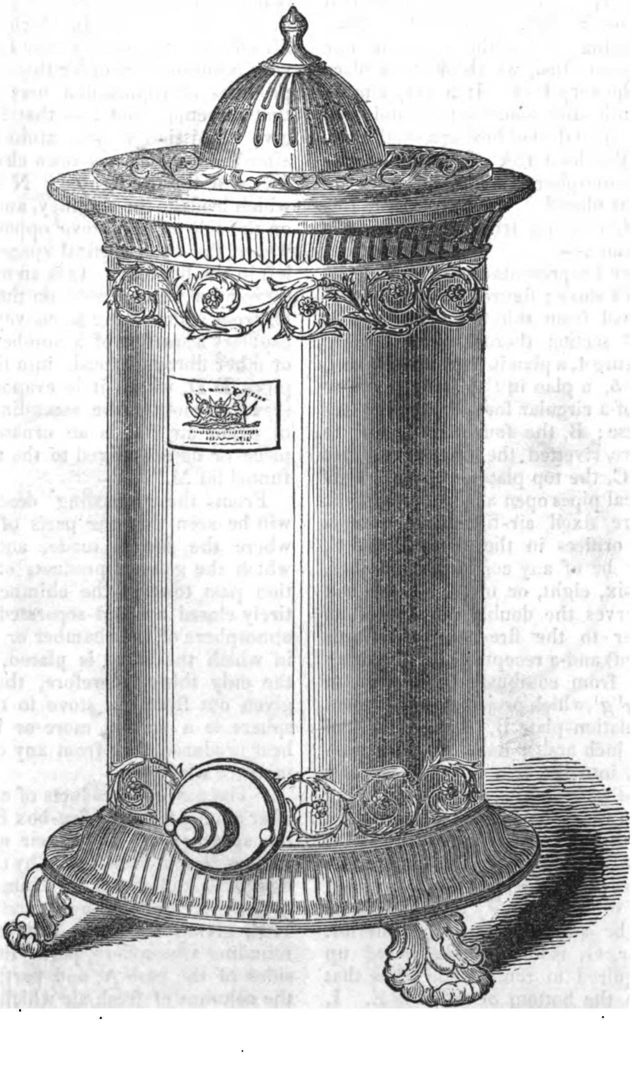
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1034.] SATURDAY, JUNE 3, 1843. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

POPE'S DOUBLE ACTION RAREFYING STOVE.

Fig. 1.



POPE'S DOUBLE ACTION RAREFYING STOVE.

[Patent dated, Dec. 6, 1842; Specification enrolled, June 2, 1843.]

NUMEROUS though the competitors for public favour in the stove way be already, it cannot be deemed surprising that every season should continue to add to the list, as long as we see so many indifferent ones in extensive use, and some even that are a disgrace to the mechanical science of the country, in considerable repute. The competition is so active, only because there is so much room and occasion for it. The stove which we have now to bring under the notice of our readers is entitled, we think, to a place among the very best. It is very simply and scientifically constructed, and will furnish a great deal of heat at a small cost, without the least risk of its deteriorating the atmosphere of any apartment in which it is placed. We extract the following description from the patentee's specification:—

"Figure 1 represents an external elevation of this stove; figure 2, a vertical section thereof from side to side; figure 3, a vertical section thereof from front to back; figure 4, a plan in the line *a b;* and, in figure 5, a plan in the line *c d.* The stove is of a circular form. A is the external case; B, the foundation plate, to which are rivetted the ornamental feet *f f*, and C, the top plate or cover. D D are vertical pipes open at top and bottom, which are fixed air-tight into corresponding orifices in the plates B and C, and may be of any convenient number, as four, six, eight, or more. E is a box which serves the double purpose of an air feeder to the fire-box (afterwards mentioned) and a receptacle for the ashes resulting from combustion; it rests on trivets, g^1 g^1, which project upwards from the foundation-plate B, to the height of about an inch and a half. F is the passage way into the box E (the two parts being cast together in one piece,) being closed at the mouth with an air-tight door G, through which a damper, H, is passed with a screw on its spindle, by the unscrewing of which, more or less, a greater or less quantity of atmospheric air can be admitted into the interior. The door, G, is made to be raised up when required to remove the ashes that collect in the bottom of the box E. I, is the fire grating which rests in a recess in the top of the box E. K is a fire-box which is placed on the grating, and has a number of open vertical spaces *g g*, on one side near to the top, through which the gaseous products of combustion may escape. L is a funnel for the supply of fuel to the fire-box, which fits at bottom into a recess in the top of the fire-box K, and passes out at top through the cover C, with which it is made to form an air-tight joint. M is the lid of the funnel L, which is made to lift off and on, and to fit the funnel head very accurately, in order that none of the products of combustion may escape in that direction, and also that it may not give admission to any atmospheric air after the fire-box has been charged with fuel and the fire lighted. N is the flue, which leads to the chimney, and is placed on the side of the stove opposite to that where the open vertical spaces, *g g*, are left in the fire-box. O is an annular reservoir for water placed on the top plate C, from which water is conveyed by the capillary attraction of a number of cotton or other fibrous threads into the vertical pipes D D, where it is evaporated, and serves to moisten the ascending columns of warm air. P is an ornamental top piece or dome, affixed to the top of the funnel lid M."

From the preceding description it will be seen that the parts of the stove where the fire is made, and through which the gaseous products of combustion pass towards the chimney are entirely closed up, and separated from the atmosphere of the chamber or apartment in which the stove is placed, and that the only thing, therefore, that can be given out from the stove to that atmosphere is a portion more or less of the heat produced, free from any deleterious mixture whatever.

"The gaseous products of combustion after issuing from the fire-box K, through the spaces *g g*, make their way in the various directions indicated by the arrows, figs. 6, 7, and 9, to the chimney filling the case A, and circling round the pipes E E, giving out their heat to the surrounding atmosphere, partly through the sides of the case A, and partly through the columns of fresh air which are continually ascending in the pipes, and passing out from them, the rarification of

Fig. 2.

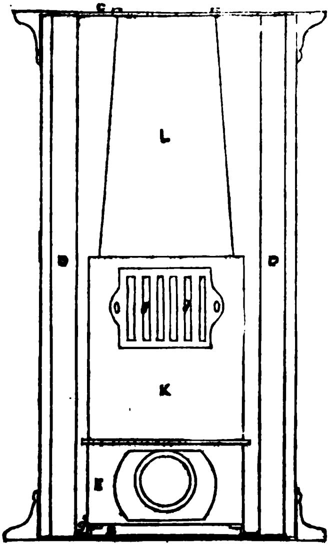


Fig. 3.

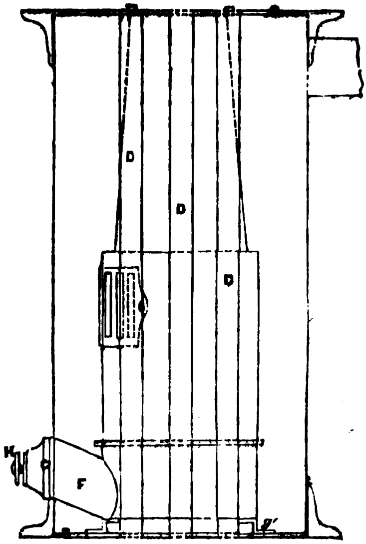


Fig. 4.

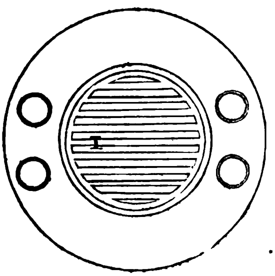


Fig. 5.

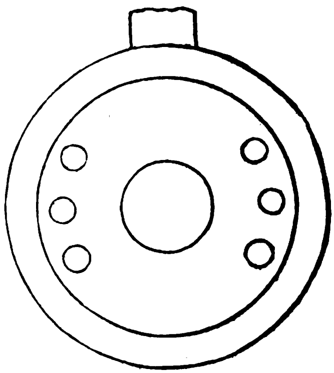
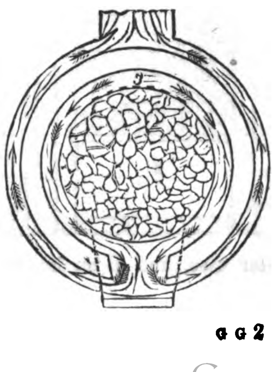


Fig. 6.

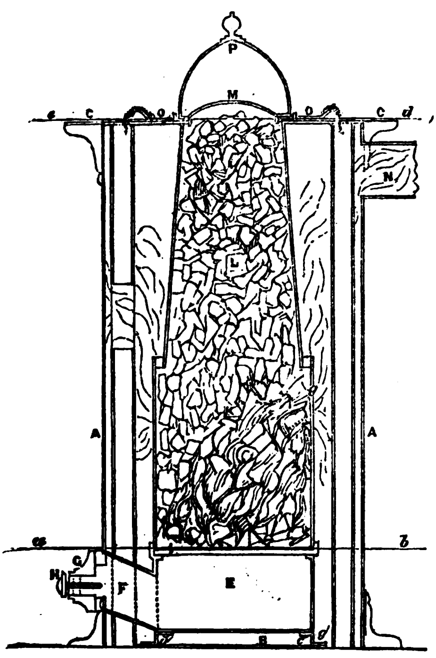
Fig. 7.



each column causing the ascent of that which follows. The supply of atmospheric air which is required to support combustion within the fire-box, being admitted only through the small orifice in the door G, and under the control of the rod H, the superior pressure of the external atmosphere prevents the possibility of any deleterious gases being driven back in that direction. The water again, which is evaporated through the medium of the capillary conductors *h h*, serves to prevent that excessive dryness which stoves, as ordinarily constructed, impart to the air of the apartments in which they are fixed.

"Instead of the ascending air pipes, D D, being of a circular form, they may be of the form of a section of a circle as represented in the plan, fig. 6, or of any other equally efficient form. Or such pipes may be altogether dispensed with, and the stove constructed in the manner represented in the plan fig. 7, and sectional elevation fig. 8. Here A

Fig. 8.



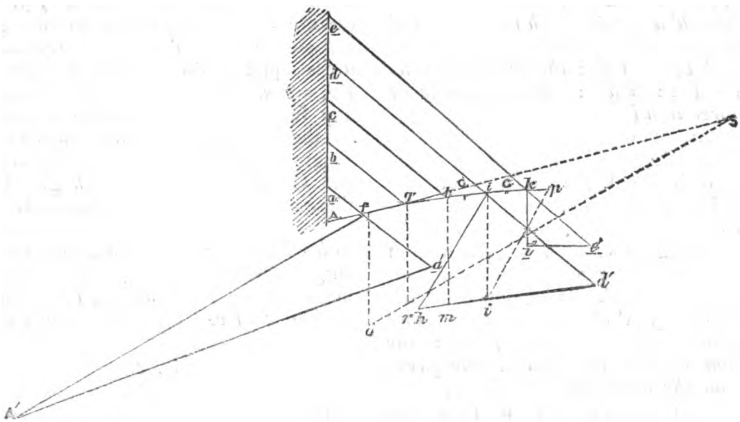
is an outer case, and B an inner one, concentric to the other, connected together by a few cross pieces *x x*, leaving a free space *s s*, between them, open both at top and bottom, up which a current of air will begin to flow continuously as soon as the stove is heated in the same way as when pipes are employed, though with less rapidity. The best situation for the vertical openings in the fire-box for the escape of the gaseous products of combustion, is in this form of stove, immediately over the mouth-piece of the air-feeder and ash-box E, whence they are conveyed through the circular channel T, to the chimney flue N. In all other respects, this stove is the same as that first described."

"The chimney piece is in all the preceding forms of stove, placed on the side opposite to the vertical openings in the fire-box, but the patentee thinks it may be desirable to cause the gaseous products of combustion to take a more circuitous course to the chimney, in order that they may be more completely exhausted of their heat before escaping into the external air, and for this purpose he proposes to place these vertical openings nearly fronting the chimney flue, as represented in the plan, fig. 9, but with a vertical

Fig. 9.

partition, V, inserted between the outer case and the fire-box and funnel from top to bottom, in order that the gaseous column may be compelled to make the entire circuit of the stove before it escapes into the chimney."

Fig. 1.



Sir,—Perhaps you will allow me space to point out a few errors in Mr. Clive's letter on the principles of suspension bridges that was published in No. 1032 of your Magazine.

If a bracket were constructed in the manner he has shown in fig. 1, with the platform curved, as represented in the diagram, the strain in the several tension cords would not vary as indicated by the weights, and described in his letter; in fact, the magnitude of the tension in the last cord towards the abutment, which he has represented by the largest weight, is less than the tension in any other cord in the system. For let A *k*, fig. 1, be the curved platform, and divided, so that *k i*, *i h*, &c, may correspond to the portions 5, 4, &c., and let them be supported by the tension lines *e k*, *d i*, &c.: as the platform is imagined to consist of loose blocks, that is, *k i*, *i h*, &c., are unconnected, and only pressing against each other at the joints *i h*, &c., it is evident that, this being the case, to maintain any portion or block, as *k i*, of the platform in equilibrium, three forces must of necessity be exerted, viz, the weight of the block in the direction of gravity, the tension in the cord *e k*, and a pressure in the direction *k i*, upon the point *i*. The next block *i h*, in addition to these forces, has to bear another, viz., that just mentioned, acting in the direction *k i*. Let us now axamine minutely the action of the various parts of the bracket, and for that purpose let the weight of each block be supposed equal; let G be the centre of gravity of *i k*, and equidistant from *i* and *k*; therefore the weight, if concentrated, one half would be supported at *i*, the other half at the point *k*; also the block *h i* would rest one half its weight on *h*, and the other half at *i*; consequently *i* would have the weight of a whole, or rather two half blocks, to sustain. In short, the weight at each of the points *f g h i*, would be equal to the weight of one block; but the weight at the abutment A, and the extremity *k*, only half a block. Draw the line *k i'*, to represent the weight at the point *k*: produce *e k* onwards; and draw *i' e'* parallel to *i k*, until it intersect the line just produced in the point *e'*; and the triangle *k i' e'* will represent the triangle of forces when the block *i k* is in equilibrium; that is, *k i'* : *the weight supported at the point k* : : *k e'* : *strain on the cord e k* : : *i' e'* : *the force on i in the direction k i.*

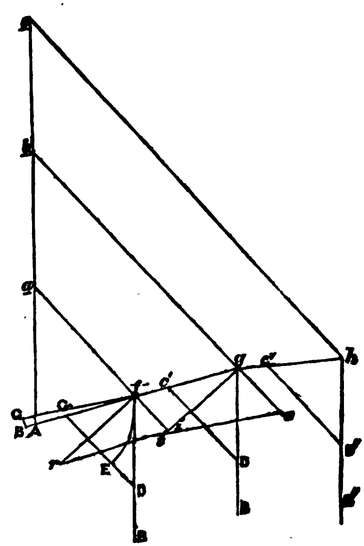
I have before stated that there is twice the weight supported at *i* as there is a the point *k*; so draw the dotted line *i l* = 2 *k i'*, and it will represent the weight acting at *i*: but there is an additional force to be taken into consideration, viz., one equal to *i' e'*, acting in the direction *k i*. Produce *i k* to *p*, and make *i p* = *i' e'*; from *p* draw the line *p l*, and it will be the resultant of the two forces

i p, *i l*, and represent the magnitude and directiðn of the force acting at the point *i*; from *i* draw *i k'*, parallel and equal to *p l*; produce *d i* onwards to the point *d'*; draw *k' d'* parallel to *h i*; then *k' i d'* will be the triangle of equilibrium for the block *h i*; or, *i d'* : *the tension in the cord i d* : : *k' d'* : *the magnitude of the force in h i*.

In this manner, if we proceed to demonstrate the triangle of forces to maintain the block A *f* in equilibrium, we shall find the weight resting on the point *f*=*f o*, and the pressure upon *f* in the direction *f g*=*f s*; then the resultant of these forces would be in the direction of, and equal to, *f* A′. If we now construct the triangle *f* A′ *a′* in the manner before described, we shall have, *f a′* : *the tension in f a* : : A′ *a′* : *the pressure on the abutment* A. Hence, then, the strain in the cord *a f* is less than that in any other of the tension cords, excepting only the one *e k*; and this one would be greater than either, but that it has only half the weight in the direction of gravity which the other cords have to support. Mr. Clive would have been more correct had he placed the larger weight at the top, and reduced them downwards; and if the platform were level, instead of being curved, then the tension in each cord would be the same, and the variation exhibited above would not obtain. Again, if in Mr. Clive's diagrams, fig. 1 were to touch fig. 2, not any of the forces existing in the one could be transferred to the other, for whatever force is in the platform it tends from the centre towards the abutment; but were they connected, and the abutments removed, then there would be a tension at the central connexion.

If a load of one ton were placed on A *f*, fig. 2, and cause only half a ton pressure upon the abutment A, in the direction *f* A, the tension in the cord *f a* would much exceed half a ton; for, from the point *f* draw *f* B, of any convenient length, which may represent one ton weight; and from *f* towards A, mark off *f c*, equal to half *f* B; parallel to *a f* draw C D; and it will represent the tension in *a f*. *f* C is by construction = half a ton = the pressure on A, and *f* D the weight, or that portion of the ton supported at the point *f*; but C D exceeds the representative of half a ton by the distance E D, and consequently the tension in *a f* is increased by C E + E D, and not by C E, as supposed by Mr. Clive. If the weight of one ton be pushed onward to the next compartment *f g*, and cause half a ton pressure in the line *g f*, and on the point *f*, then the tension in *a f* is equal to *f s*, and the pressure in *f* A = *r s*. But this process does not go any further; for, let the ton be placed on the block *g h*, then *h* D″ will be the weight at *h*, C″ D″ the tension in *c h*, and C″ *h* the pressure in *h g*. At *g* there are two forces, one equal to B″ D″ in the direction of gravity, and one equal to *h* C″ in the direction *h g*; the resultant of these is shown by the line *g t*; hence the tension in *h g*=*g v*, and pressure on *f*=*t v*. This is the only force

Fig. 2.



to be resisted at the point *f*, (of course supposing the platform void of weight,) for the whole weight of the ton is supported by the bars forward. Hence, as the force on *f* is in the direction *g f*, a pressure downwards in *a f* would be necessary to keep the block A *f* from rising; this is evident, for produce *g f* to G, and draw G H parallel to *a f*, then, as the triangle *f* G H is constructed above the block A *f*, the line *a f* would have to resist a compressive, and not sustain a tensile force; and the magnitude of such

compressive force is represented by G H. This comes from the platform being curved. I would, therefore, suggest the propriety of keeping it level, for there is no advantage obtained from raising the platform in the centre, but many disadvantages attending such an arrangement, not the least of which is the great inconvenience for transit loads. I would also beg leave to observe, that if all the tensile bars had been carried to the top, instead of being supported at equidistances up the towers, he would have obtained nearly twice the versed sine for his bracket, and made it in the same proportion stronger.

I do not know what Mr. Clive's plan for suspension bridges may be, but I assure him the suppositions in his letter are erroneous.

As Mr. Clive has mentioned the Victoria, in comparison with the Tiverton bridge, you will perhaps permit me to refer to a few statements already published. I would, however, premise that he is mistaken in saying there is a swinging motion in the bridge; such motion does not exist, nor had I ever heard any person say there was, until I read Mr. Clive's letter. On the old chain bridge, with catenary curve, there is the destructive motion he describes. From the description given of the Tiverton bridge in No. 1026 of your Magazine, it appears it is 120 feet span, with 14 feet width of platform, and cost 2500*l*. The Victoria bridge is 150 feet span, the platform is 19 feet wide, which is covered with stone, and macadamized as the common road. The weight of stone upon it is about 70 tons. This bridge cost only 1600*l*.

Sir, I remain, &c.

JAMES DREDGE.

P. S. The fence of the Victoria bridge is of iron, yet, notwithstanding, the quantity used in the whole structure is not so great as that consumed in the erection of the Tiverton bridge.

MESSRS. WRIGHT AND BAIN'S DISCOVERIES IN THE TRANSMISSION OF ELECTRICITY.

Sir, — A paper descriptive of Mr. Cooke's telegraph having recently been read at a meeting of the Society of Arts,* in which it is stated that he has *for two years* used the earth as one half of the electric circuit, in the telegraph used on the Blackwall railway, and this paper has been quoted in various periodicals. This discovery is evidently not considered a secondary object, from the prominence given to the advantages said to arise from it, viz., "1st. one wire is saved in each circuit, thus diminishing complexity and cost; and 2nd. The earth acting as a vast reservoir of electricity, the resistance offered to the transmission of the electricity is vastly diminished, and the battery is able to work through a much greater distance, with a smaller wire." As I am much interested in the subject, I beg, as a particular favour, the insertion in your valuable journal of the following reasons for doubting the correctness of the *two years' date*.

1st. If this discovery was made *two years* since, why was it not patented *at the time?* A discovery of this importance to the pursuits of Messrs. Cooke and Wheatstone was certainly well worth the expense; but still this was not done. Nay, more, these gentlemen took out a patent at this very time for improvements in their telegraphs, (*sealed*, July 7, 1841; *specified*, January 7, 1842,) in which not the *slightest allusion is made to the earth as part of the electric circuit.*

2nd. In the spring of last year Mr. Cooke published a book upon electric telegraphs in connexion with railways, in which, when mentioning the number of wires necessary, *not the slightest allusion was made to the earth as part of the electric circuit.*

3rd. On the 2nd of June last, Mr. Alexander Bain and myself publicly showed in Hyde Park, the great advantage of using any body of natural water, or the moisture of the earth *as one half of the electric circuit* in the construction of electric telegraphs. If to the ends of the metallic portion of the circuit large surfaces of metal were attached, in contact with the water or moisture, they delivered the current from the wire to the moisture, and from the moisture to the wire; and this was noticed in, I believe, every periodical published in London within the week, including the *Mechanics' Magazine*, which notice was thus circulated, unquestioned by these gentlemen, either as to the priority or originality of this discovery; and I think it shows bad taste in them now to endeavour, in this not very straight-

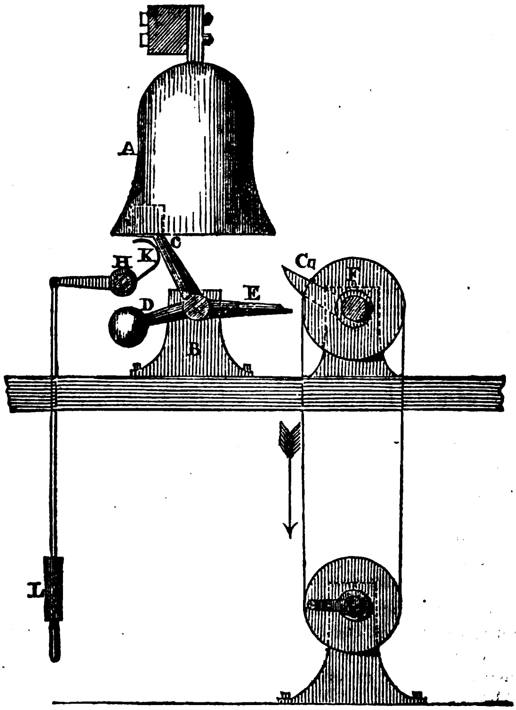
* The substance of it is given in a subsequent article, p. 467.—ED. M. M.

forward way, to claim that which I really believe does not belong to them. It is usual, I believe, for those who first ascertain and publish a *new* scientific truth to be considered as the discoverers of the same; but if third parties, after twelve months' *knowledge*, and twelve months' *silence*, are allowed to claim the precedence for twelve months, original discoverers will never be safe. This is exactly the position of Mr. Bain and myself, for we do not pretend to have *positively ascertained* the use of the moisture of the earth, as part of the electric circuit, until the early part of last year, whereas, Mr. Cooke now comes forward for the first time, and says, that "*he has used it efficiently for about two years*, on the Blackwall railway!"

I am, Sir,
Your obedient servant,
THOS. WRIGHT.

Thistle Grove, Brompton-road,
May 29, 1843.

IMPROVED MODE OF RINGING PEALS OF BELLS.



Sir,—It will, I believe, be admitted on all sides, that the present absurd system of bell-ringing as practised in our cathedrals, churches, &c., calls loudly for improvement, some prevention, in fact, of the extensive injuries which the towers are continually receiving from the vibration of so heavy a body, being in several instances some tons in weight. According to my view of the matter, the foolish mode of knocking the bell against the tongue is something like the plan of those wiseacres, who hoisted their cow upon the house-top to eat the grass which grew there.

I prefix a sketch of a plan which I designed a short time back, for ringing a peal of bells by means of hammers, detached entirely from them—the bells themselves being stationary. This will be found to combine several advantages, besides annihilating the evils abovemen-

tioned. Not the least is, that skilled labour is not required for their management; any person may ring them, who has strength for the task, which is well known is not the case with their present construction, as few men are good ringers, and only attain perfection by considerable practice. In this case also, they may be altered to any particular change in a few minutes, and the intensity of the blow of the hammers may be regulated to the greatest nicety. A reference to the sketch will, however, give your readers a better idea of my views upon the subject.

A is one of a row of bells; it is firmly bolted to a beam, so as not to allow of its moving; B is a short pedestal, which supports a short shaft, carrying the lever C, with the hammer attached, which works inside the bell; also the lever D, carrying a weight for bringing down the hammer upon the bell; E, the lever, by which the alternating motion is given; F is a drum, keyed upon a shaft, which runs alongside the row of bells, and is driven by a strap, from another below, which has a winch attached for driving it. On this shaft are fixed a set of cams, (one of which, C, is shown,) which, upon the revolution of the shaft F, catch the lever E, and lift the hammer, the counterweight, bringing it down upon the bell, when released from the cam; H is a slight shaft, fixed in suitable bearings, carrying a spring K, which is so fixed as to keep the hammer off the bell, when it has fallen. L is a rod communicating with the room below, and connected with the shaft H, in such manner that a pull in either direction will increase or relax the tension of the spring K, so as to modulate the blow of the hammer to any required degree. It is fitted with a handle at its lower end, and also a plate having a set of holes drilled through it, for the purpose of hooking it on a pin, at any requisite height, for a small set of bells, such as are used in village churches. One man at the winch will be amply sufficient.

To change the time of ringing of each bell, a slight shift of the cam belonging to it, in either direction, will accomplish this. The greatest advantage, however, which would accrue from the use of a plan upon this principle is, the doing away with all vibration, which has destroyed a great number of steeples. I am, yours truly, WILLIAM JOHNSON.

Preston, May 24, 1813.

THE ELECTRIC TELEGRAPH—MR. COOKE'S IMPROVED SYSTEM AS APPLIED TO THE GREAT WESTERN RAILWAY.*

[From a Paper read before the Society of Arts, by Francis Whishaw, Esq., Secretary.]

Mr. Cooke has recently invented and carried out on the Great Western Railway, a plan of suspending the conducting wires in the open air from lofty poles. About ten miles of telegraph are thus completed: and I will now describe the details of this plan, which will, beyond all doubt, supersede every other method.

Its leading advantages are—

1st. Diminished cost.

2nd. Superior insulation; and,

3rd. Facility of repair.

The old plan consisted of laying copper wires, covered with cotton and carefully varnished, into smooth iron tubing, with frequent arrangements for obtaining access to the wires, and for the facility of examination and repairs.

The tube, after being carefully tarred, was either buried in the ground or fixed on low posts and covered with a wooden rail. This plan will still be occasionally applied, in conjunction with the new one, in tunnels, towns, &c.

The cost of the original plan stands nearly as follows:—

	£	s.	d.
Prepared ¾ tube, varnished within and without, 5¼d. per foot	115	10	0
Six copper wires, covered and varnished, at 6*l*. 15*s*. per mile	40	10	0
Labour and carriage per mile	27	0	0
Iron fittings, boxes, &c.	12	6	0
Tar, pitch, paint, rosin, and sundries	15	0	0
Posts and rails, at 3½d. per foot, including fixing	77	0	0
Making the total cost per mile	£287	6	0

To which a per-centage for casualties, profit to the contractor, and the price of instruments, remain to be added.

The present plan of suspension may be estimated thus:—

	£	s.	d.
Drawing posts, with winding apparatus, per mile	48	0	0
Cast iron standards with insulators (22 in a mile,) per mile	52	0	0
Labour in fixing and painting, per mile	12	6	0
Anti-corrosion paint and tar, per mile	11	0	0
Carriage tools, and sundries, per mile	13	0	0
Contingencies, per mile	13	0	0
Total	£149	6	0

making a reduction of about 50 per cent. in favour of the present plan, and a still greater advantage in favour of the permanence of the work.

The present method of proceeding in laying down the telegraph is, first, to fix firmly in the ground at every 500 or 600 yards,

* For previous accounts of the Electrical Telegraph, see *Mech. Mag.*, vol. xxxiii., p. 161, and vol. xxxiv., p. 433.

strong posts of timber from 16 to 18 feet in height, by 8 inches square at bottom, and tapering off to 6 by 7 inches at top, fixed into stout sills and properly strutted. Attached to the heads of these posts are a number of winding apparatus, corresponding with the number of conducting wires to be employed, and between every two of such posts, upright wooden standards are fixed about 60 or 70 yards apart. A ring of iron wire (No. 7 or 8) which has been formed by welding the short lengths in which it is made together, is then placed upon a reel carried on a hand-barrow, and one end being attached to the winder at one draw-post, the wire is extended to the adjoining draw-post, and fixed to its corresponding winder at that post; by turning the pin of the ratchet-wheel with a proper key the wire is tightened to the necessary degree; thus the greatest accuracy may be attained in drawing the wires up till they hang perfectly parallel with each other. To sufficiently insulate the wires so suspended at the point of contact with the posts is an object of indispensable importance, as the dampness of the wood during rainy weather would otherwise allow the electric fluid to pass off freely into the earth, or into an adjoining wire, and thus complete the circuit without reaching the distant terminus at which the telegraphic effect is to be produced. In this, indeed, lies an important feature of Mr. Cooke's invention, as the mere idea of supporting wires in the open air from poles, trees, or church steeples, is the oldest on record. To effect this object, at the draw-posts wooden boxes are employed to enclose that portion of the post to which the winders are attached, and small openings are left for the free passage of the wires, without risking any contact with the outer box. The standards are furnished either with covers parted off by an overhanging roof between each wire, and again between the lowest wire and the earth, or by a series of metal shields. An eye of metal, with a slit on the upper side, forms a hook to support the wire; and to insulate the wire from the hook, which might otherwise act as a conductor to the dampness in the wood, a split quill is slipped over the wire on which it rests. The whole is then carefully painted with several coats of anti-corrosion paint; or asphalte varnish may be employed for the wires. When the wires are to be varnished, they are unhooked from the upper ends of the standards, and lowered to nails temporarily fixed to receive them toward the bottom of the posts. A painter furnished with a can of paint hung on his shoulder, a brush, and a piece of felt, takes each wire and rapidly coats it, when it is again hooked up in its position at the top of the standard. This is the simplest and cheapest method now adopted. But for long distances Mr. Cooke employs earthenware or glass for his insulation, and cast-iron standards and posts with ash tops, for drawing and suspending the conductors, which, instead of single wires, will be strands of six or more wires twisted together. For very great distances, when very superior conducting power will be needed, a copper wire will be placed in the centre of the strand, and whilst it adds but little to the weight, it will more than double the conducting power thereof, the iron wire still giving the necessary strength to resist tension. The relative conductive powers of copper, and the softest iron wire, are nearly as 7 to 1. Various methods are adopted in passing under bridges which answer the purpose of draw-posts, the winders being fixed to a piece of wood partly let into the brickwork to avoid damp, the greatest enemy to electric conduction. These earthenware insulations are introduced between the winder and wire. Mr. Cooke also intends to use caps or boxes of earthenware to surmount the iron standards. At Slough, for half a mile in approaching and passing by the station, cast-iron standards and draw-posts are employed, the effect of which is remarkably light and elegant. A line of six wires is there completed, and in crossing over a carriage shed immediately opposite to the station, the wires are stretched over a length of 438 feet without any intermediate support, and so accurately are they arranged, that no difference is perceivable in their parallelism. The draw-posts in this instance are half a mile apart, although the line is slightly curved. In passing over a station or an accommodation road, or in crossing the railway, loftier standards are employed, which abruptly lift the wires to the height of 25 to 30 feet in order to clear objects passing below. In the latter case lighter wires are employed, that the tension out of the direct line of strain may not draw the standard from the perpendicular.

The ordinary precautions of charring, pitching, and kyanizing the posts are carefully attended to; but in case of the decay of a standard near the earth, then it is only necessary to provide a new piece for the bottom, to which the upper portion can be spliced. The method of letting the standards into the earth is novel and convenient. For this purpose Mr. Cooke employs a boring tool accurately agreeing in size with the iron standards, and rather larger for the wooden ones. The level, taken from the rails, gives the depth to which the standards are to be sunk, which is chalked on the boring tool, and in the course of a few minutes, where the soil is suitable, the hole is

opened and the standard fixed, and rammed closely round the sides without the soil being disturbed.

An admirable point in this system is, its adaptation to cases where a telegraph is only occasionally required, as in the repairs of railways, when one line is temporarily closed on the falling of a bridge, or slipping of an embankment as on the Croydon line. The materials being in store are conveyed to the spot, the holes bored for the posts, the wire strand run out, and a telegraph is working in a few hours. Upon the necessity ceasing, the strands are again wound up, the posts lifted and sent again into store, in readiness for the next emergency.

The last advantage which need be noticed in connexion with this very important step in the invention arises from the very perfect insulation from the earth. This allows of the employment of the earth as half of the conducting circuit, without risk of the current finding a shorter course through some imperfectly insulated point. For nearly two years Mr. Cooke has tried this plan successfully on the Blackwall Railway, and since on the Manchester and Leeds Railway; but where, as in these instances, the wires are enclosed in an iron pipe, there is always danger of a contact either partial from a few drops of moisture, or perfect from the metals of the wire and pipe touching, in which case, as before observed, the electricity takes a short course instead of performing its entire circuit, and no signal is given at the distant terminus though appearing very strong at the point whence it sets out. With the wires suspended in the air no such danger exists, whilst two advantages spring from the employment of the earth as a conductor:—

1st. One wire is saved in each circuit, thus diminishing complexity and cost. And,

2nd. The earth acting as a great reservoir of electricity, or as some think as an excellent conductor, the resistance offered to the transmission of the electricity is vastly diminished; and the battery is able to work through a much greater distance, with a smaller conducting wire.

It is thus that the apparatus exhibited can be made to work with two wires only.

An important point to observe in this arrangement, next to good insulation along the line, is to have the branch wire, going from the instrument to the earth, brought into connexion with as a large a surface as possible. At Blackwall this is effected by simply uniting the branch wire to the gas pipe which lights the Telegraph Office. This pipe is in connexion at numerous points with the engine, and is a continuation of many miles of gas pipe in the ground, also gasometers, water pipes, &c. On the Great Western it will be connected with the engine that pumps the water at Slough, and also with the gas pipes at Paddington.

THE SMOKE NUISANCE.

The following is the substance of a report by the Sub-committee of General Commissioners of Police of Edinburgh, appointed to visit Glasgow, and to report on the best means used there for preventing the smoke of furnaces:

"In compliance with the remit from the board, your committee, consisting of Messrs. Cassels, convener, Tullis, Veitch, Thomson, and Miller, beg to report, that, on the 20th April, they proceeded to Glasgow to make the necessary investigations and inquiries as to the practicability and best mode adopted in that city for the consumption of the smoke of the furnaces of manufactories and other works. Prior to this, arrangements had been made as to the works which were to be visited. The committee also requested Mr. Charles Dick, brewer, to go with them, and a deputation from the Stockbridge flour mills also accompanied them.

"The committee, on their arrival at Glasgow, found Bailie Alston waiting for them; and they would here express their thanks to that gentleman for the attentions shown by him.

"Accompanied by Mr. Butler, they proceeded to Messrs. Houldsworth's manufactory, at Anderston, where there are two furnaces, fitted upon Mr. Williams's principle, under boilers which supply steam to an engine of sixty horse-power.

"These furnaces were repeatedly stocked with fresh fuel, in presence of the committee, and little, indeed no black smoke, was emitted from the top of the chimney-stalk, so long as the patent was applied; but, in order to test the matter thoroughly, the committee got the patent principle stopped off from the furnace, and, immediately, dense volumes of black smoke issued from the chimney-top. These trials were repeatedly made with the same uniform results.

"The committee had a long conversation with Mr. Houldsworth, who stated, that he had used the patent for above two months; that it is the only practical mode he has ever seen of thoroughly consuming smoke. The patent answers well, and he decidedly approves of it. There is no defect of power in using it. He has not yet been able to notice any great saving of fuel; but, still, there is a saving of fuel in using it, as he has always worked his furnaces on the most economical principles.

"Mr. Houldsworth's statement was cor-

roborated in every respect by the furnace-stoker, who stated, that he kept up the steam quite as easily by the patent furnaces as by the old ones.

"The committee noticed that the coal used at this manufactory was *dross.*

"The committee also visited Messrs. John Denniston and Co.'s Spinning Mill, at Mile-end. Here Mr. Williams's patent has been used for eight months. At this manufactory there are four furnaces under boilers supplying steam to a ninety horse-power engine.

"These furnaces were minutely examined, and were frequently supplied with fresh fuel in presence of the committee, and no smoke was given out at the chimney-stalk; but, the instant the patent principle was shut off, dense volumes of black smoke issued from the top of the chimney.

"The committee also visited the *Shandon*, steamer, lying at the Bromielaw, which is fitted up with an engine of eighty horse-power, supplied with steam from two boilers furnished with Mr. Williams's furnaces. These have been used for two months.

"No fires were under these furnaces, and this afforded the committee an opportunity of minutely examining their principles and construction, with which they were very much satisfied.

"Captain M'Lean, the commander of the *Shandon*, stated, that there is no smoke emitted from the funnel of the vessel. That he has the same quantity of steam generated by the patent as formerly by the old furnaces; has the same number of revolutions of the paddle-wheels and piston strokes per minute as formerly; and has proved the certainty of this by using a stop-watch. There is a considerable saving of fuel, by using Mr. Williams's patent, to the extent of fifteen per cent. This has been proved by weighing the coals.

"George Lang, the stoker of the steamer, corroborated what was stated by Captain M'Lean. That there is no smoke at all from the furnace. There is the same power of steam, and, less coals being used, the saving on this article is twenty-four cwts. on the voyage from Glasgow to Greenock and back.

"The committee also visited the works of Messrs. Kerr, Nelson, and Co., engineers, where the patent furnaces are made, and had the information and explanations of Mr. Kerr thereon.

"Such, then, is the state of facts as seen by your committee, and they now beg to report, as their unanimous opinion,—

"That the patent furnace of Mr. Charles Wye Williams effectually consumes smoke, and is the most effective mode known for consuming the smoke of manufactories.

"This result appears to exhaust all in which the commissioners of police have any interest regarding this matter. But your committee are also of opinion:

"1. That there is no loss of power by using Mr. Williams's patent.

"2. That there is a considerable saving of fuel.

"3. That small coal or dross is preferable to great coal in using this patent.

"In conclusion, your committee would recommend to the Board to vote a sum not exceeding £ , for the purpose of assisting in the erection of one of Mr. Williams's patent furnaces to be fitted up in one of the manufactories in Edinburgh, in order that the public and manufacturers may be satisfied of the practicability of smoke being consumed."

ON THE MEANS EMPLOYED IN DIFFERENT COUNTRIES FOR THE PROMOTION OF MANUFACTURES AND THE MECHANIC ARTS, AND OF THE INTELLECTUAL IMPROVEMENT OF THEIR CULTIVATORS.

[From an Address delivered by Professor Bache, at the Exhibition of American Manufactures, October, 1842, published at length in the "Franklin Journal," and deserving of universal attention for its sound and enlightened views.]

The traveller in the deserts of Syria, resting at one of those few favoured spots where the turf shows the presence of the refreshing well, and the date palm gives him shade, finds himself amid the ruins of a great city. Broken columns—architraves, and fragments of pediments half imbedded in the sand—heaps of ruins, indicating the former existence of massive structures, and deluding him with the idea that even now he may trace the extent and form of the space once occupied by the dwellings of men—all speak of the magnificence, the grandeur, and the vastness, of a great commercial capital. He is amid the ruins of Tadmor of the wilderness, Palmyra, the great commercial emporium of former days—now part of the greater desert. Here was once the entrepôt of the commerce of the east and west, and here arose a city—as it were, one vast temple to that commerce which linked together the far east and west.

Amid the lagunes and marshes at the head of the Adriatic the gorgeous fane and splendid palace are reared, and the varied ornaments of a florid architecture are lavished to decorate the homes of the merchant nobles. The very difficulties of the site are made to contribute to luxury: no noise of wheels disturbs the quiet of home, or the hum of business on the Rialto, but the luxurious gondola glides silently through the vast canals which connect the distant quarters of this queen of the sea. Commerce has been again

at her work. Civilization has advanced westward; and while Tadmor is crumbling, and the sands of the desert are gathering over its ruins, Venice is rising from the waters, the new entrepôt of commerce between the east and west.

A new route is discovered, by which the products of the agriculture and arts of India are conveyed to Europe; commerce departs with prosperity in her train, and Venice is given over to the destroyer.

In the early periods of history these changes were few, their progress was gradual, like the slow changes of the scenes of a diorama: ages elapsed before the tide ceased to set through Palmyra. In modern times the changes are like those of the kaleidoscope, sudden and striking. Agriculture changes its objects or its methods—manufactures spring up and flourish, or decay—the arts find new seats and new subjects for their exercise—commerce, which connects the producer and the consumer, runs in new channels. Cities greater than Tadmor or Venice spring up, the creations of a new civilization.

Increased production, whether in agriculture or manufactures, is so obvious and powerful a source of prosperity to a country, that we naturally look with interest upon every circumstance which may affect it, endeavouring, as far as may be, to understand, that we may aid. While all are agreed as to the necessity for cherishing agriculture, manufactures, the mechanic arts, and commerce, as the essential elements of national wealth, few agree as to the means of protection. One would think that by this time facts enough had been accumulated to settle all doubts, and to establish a science whose principles should be as well ascertained as those of the philosophy of nature. But the passions, prejudices, and interests of men must be overcome before they desire to find the truth; and then all the difficulties remain of interpreting the results of complex experiments, and of assigning the just influence to each of their numerous and varied attendant circumstances.

It is conceded, in every civilized community, that the products of its agriculture, manufactures, and arts, should be brought as nearly as possible to perfection, and that improvement is the necessary consequence of the increased intelligence of those who follow the various callings connected with them. Avoiding, then, debated and debateable ground, and planting ourselves upon that which is fully and fairly our own, it may be profitable for us to consider *the means employed in different countries for the promotion of manufactures and the mechanic arts, and of the intellectual improvement of their cultivators.*

From this general survey we may derive materials for a comparative estimate of our own efforts—encouragement it may be, or stimulus to increased exertion; hints of new lines of usefulness, or assurance that perseverance in those in which our efforts are already directed will ultimately be crowned with success. In a country like this, where public opinion makes, alters, or repeals the laws, there is always reason to hope for the success of what is right. It may not come this moment, nor the next; but, as sure as the darkness of night heralds the approach of dawn, which certifies the coming noonday, so surely will truth finally prevail where public opinion rules.

The principle of voluntary association by which, in the United States, we obtain some of our best results, is derived from the country to which we owe our origin. It is imperfectly understood on the continent of Europe, and is but feebly applied even in those countries where a semblance of political freedom exists. The government too often assumes the power to direct the mind and to control the will.

Prussia has undertaken to show what an "enlightened despotism" may effect; and the results of her combined educational, military, political, and religious system yet remain to be fully developed. The rulers have had their preferences in regard to the encouragement of different departments of agriculture and the arts. At one time, the silk culture, and the manufacture of silk and porcelain, were especially patronized; at another, brass and iron founding, and the culture of the beet, and the manufacture of sugar from it. The minutiæ to which the government descends may be perceived from the fact, that licenses to follow trades and occupations, the results of which concern human life, (as those of the druggist and chemist, of the architect and builder, of the mason and carpenter, and even of the well-digger,) can only be had upon an examination upon certain preliminary acquisitions, deemed essential to the prosecution of each.

The recommendation of general measures for promoting the interests of the useful arts is entrusted to a technical commission connected with one of the departments of the government. A society is also permitted in Berlin, which takes cognizance of inventions submitted to it, which meets at stated times to discuss reports upon alleged inventions or improvements, and under the nominal patronage of which a monthly journal is published. To provide for the technical instruction of those who intend to follow mechanical employments, schools have been established in many of the provinces, to be entered after the usual period of elementary instruction is passed, and before an apprenticeship is com-

menced, or during its first years. The most promising pupils of these schools are transferred, after serving a portion of the time of their apprenticeship, to a central school, at Berlin, where they receive, free of expense, instruction in the branches which may fit them for the occupation of machinists, founders, and the like. Architects, builders, and engineers have a similar public institution, for the preparation of the members of their professions. The Trade Institute of Berlin turns out annually a class of well-educated young men, whose influence on the occupations which they embrace must ultimately be of the highest benefit.

The plan and execution of that great scheme of uniting the States of Germany, once loosely connected by political ties in a commercial league, is due to Prussia, and now the toll-league embraces nearly all the States of the old German empire, except Austria. A uniform scale of duties is adopted by all, and import duties are collected at the frontiers, to be distributed in proportions agreed upon by the several parties.

Austria has *her* way of encouraging manufactures and the mechanic arts, different from that of Prussia. Her manufactures of porcelain, of iron, of linen, of sugar, and of chemical products, have in turn been aided. Her quicksilver mines and porcelain manufactory belong to the government, and the former are worked by a corps specially organized for the purpose. The government has established trade schools, like those of Berlin, in some of the provinces, but their great *Polytechnic Institution* is in the capital itself. No expense has been spared to collect in this establishment the best specimens of the materials used in the arts, of the tools and machines, (or models of them,) employed in the different manufactures, and of the products of industry. All are used for the purposes of instruction in the technical schools, and are accessible to the mechanic. One portion of the immense structure is occupied by the rooms devoted to these collections, and to models of architecture of various kinds, and of different countries. In one of them is a model of that admirable structure, now lost to us, the work of an American mechanic, the wooden bridge at Fairmount; and it would be curious if, one day, a Philadelphian should bring back a copy of it, to place in the hall of the Franklin Institute of Pennsylvania.

The late emperor, when heir apparent, vieing with that department of the government which had charge of the polytechnic school, collected for himself a vast museum of materials and products of the arts, presenting not only the results of Austria, but of the world—a standing exhibition of the works of the useful and decorative arts.

The stranger must be struck with the magnificence of the pile thus reared by imperial munificence, as the temple of the useful arts; and as, entering the spacious gates, he passes through the halls devoted to elementary instruction in science and languages, to the higher branches of practical science, through the laboratories, only rivalled by one among ourselves, through the extensive range of rooms for the display of materials of the arts, of models, of fabrics, of machines—through the workshop, whence some of the most accurate instruments have proceeded—through the immense galleries, devoted to a standing exhibition of the arts, manufactures, and agriculture of Austria—he cannot but admit that in *this*, at least, the government has wisely appropriated the means derived from the people for the people's good.

It is admitted by all, that, in the arts depending upon chemistry, the existence of that institution has already produced important effects; and it is generally believed that the view there afforded of the comparative essays of different manufactures has led to the improvement which the products of Austrian industry have exhibited at the German fairs.

Whether practical instruction in the workshop should precede, or follow the theoretical instruction of the schools, is a moot-point. An intelligent iron-master of Styria thought he had found the true solution to the problem, by bringing up his sons, from the time of finishing their elementary education, at the forge and furnace, and at the end of their apprenticeship sending them to the technical schools. On the contrary, the Prussian educates for the workshop in the school, requiring each pupil to go through a course of practice there; and in Dresden, the apprentices who are pupils of the Saxon Trade School work during a part of the day, and receive their technical instruction during the remainder, thus mixing theory with practice.

We may admire the efforts of the Austrian and Prussian commissions, but, after all, the plodding spirit of routine which clogs the limbs of activity in these countries renders the measure of success of the plans *there* no scale to judge of what would be accomplished where the load of despotism was not to be borne forward.

France has halted in her scientific career since the youth of the nation have drunk so deeply of the excitements of political life. In Paris, the periodical exhibitions of the manufactures of the kingdom are, doubtless, not without their influence. The Conservatory of Arts and Trades—a fine array of models and machines—chronicles the various improvements in each branch of art. The lectures of its eminent professors spread before the student the scientific principles

which he is to use. A few members in the National Institute give a representation to the arts. But these are acquisitions of a past day. The trifling public aid extended to the School of Arts and Trades in Paris—the stationary condition of the Sevres porcelain factory—the diminished glory of the Gobelins—the attacks in the Chamber of Deputies upon the Industrial School of Chalons—do not speak of progress in the old way of government support, and no new one has come into operation to replace it.

It would be easier to generalize in regard to the United States, extending, as it does, through twenty-six degrees of latitude and eighty-three of longitude, than in relation to the small territory of Great Britain. If an Englishman's house is his castle, his workship is its citadel. The establishment of Bolton and Watt is not open even to strangers, and strangers may pass into many not accessible to townsmen. Keen competition keeps men much asunder.

The Manchester man would care little for an exhibition which would bring to his town the iron of Glasgow, or the cutlery of Sheffield. Besides, neither his customers nor his judges are to be found at home. Rodgers displays his cutlery in his shop, because all great manufacturers have a show room; but he looks to America for his gains, and his agent in London occupies a small shop in an obscure street. Mackintosh* cares little whether the colours of his dyes suit the "Glasgow folk" or the "Edinboro' gentry" or not, and Strutt does not make his woollens for the consumption of Derby.

The home market is comparatively of little importance. Every man endeavours to improve as fast as he can, to surpass his neighbour—to keep, as far as he can, the ascendency which skill, or talent, or capital may have given him. The attempt of the British Association at Newcastle to bring together the products of the arts and manufactures, was but very partially successful, and it was thought that if this had been made by practical instead of scientific men, it would have failed entirely.

Are we to infer from this, that exhibitions and collections in the arts, and the diffusion of knowledge in regard to them, are all useless? England is the workshop of the world. To what purpose do we toil to promote that which can and will take care of itself? Let us examine this argument a little. Are we sure that things might not be better under a different system, even in England? Who shall say what progress the English manufacturers and mechanics might have made, had their energy been aided by greater publicity—by greater facilities for comparison? One thing may positively be affirmed, that no patriot would exchange the neglect of education on the part of many of their opulent mechanics and manufacturers, of self-improvement out of the immediate line of the workshop, of good manners and address, for the strikingly reverse trait which obtains among so many of our men of equal resources in the arts. Education make a mechanic! says the objector. Watt was educated a surveyor—Arkwright a barber—and yet the one was the great inventor of the useful form of the steam-engine, and the other of the jenny. What use of schools for special instruction in mechanics? This objection might, perhaps, have some force, if all men were Watts' and Arkwrights, if there were no *common* minds to train. It would have more force if there were no education but to make certain forms of letters, and to construct sentences, and to add numbers. Away with such limited views of education? Were Watt's powers of observation and reflection not educated? Were Arkwright's powers of invention not educated? Their lives show how *the circumstances in which they were placed educated* them for their very inventions.

But if this argument is worth anything, it is worth carrying to its full consequence. Because Burritt was brought up a blacksmith, Lukens a farmer, Baldwin a jeweller, Merrick a merchant, and Morris a druggist, we should make linguists by putting our sons to the anvil, mechanicians by requiring them to follow the plough, builders of locomotives and steam engines, and machine makers, by apprenticing them to the details of filigree work, of accounts, or of pharmacy. This seems the legitimate inference from the argument of those who, because English manufacturers and mechanics are great in their lines, would eschew schools, lectures, cabinets and exhibitions. Ask the men themselves whom I have referred to, how *they* would desire to educate *their* sons—how they would wish to have been educated, were their lives to be passed over again. Hear from them the difficulties which they have encountered for want of a different schooling. Hear from them the circumstances which have really given them their schooling. The school of life and practice is one of the hardest in which men are educated. Men who are educated in it are planting in growing time, and may be considered happy indeed if they reap before winter.

But have no attempts been made in Britain to improve the mechanic as an intellectual being? Professor Anderson of the Glasgow University, dissatisfied with the narrow regulations which constrained the institution to which he belonged, left by will his ap-

* Query Tennant?—Ed. M. M.

paratus and a small legacy to found a more liberal school. Dr. Birkbeck endeavoured to make this small foundation available for the instruction of mechanics, and classes were opened for their benefit in the institution. Voluntary associations of mechanics, under various titles, sprang up under the direction of Birkbeck and his associates, and for a time promised great things in the culture of both the adult and the youthful mind. They usually combined public lectures in chemical, mechanical, and general science, and classes of mathematics, of English, modern languages, &c., for the sons, wards, and apprentices of members. Many of them are still in existence. Some have taken root, but are found to be supported more generally by merchants of various grades than by mechanics. From the example of these associations, others for very popular instruction have been established, giving lectures at moderate rates on geography, history, and the elements of natural science.

Some of the institutions for the promotion of the arts award prizes for special excellence in particular objects, to manufacturers and mechanics, and also to the successful pupils of their schools. The Society of Arts of London, and that of Scotland, give premiums for meritorious inventions submitted to them; have papers read before them, by members, on new inventions, and the former association publishes its transactions. Each has a meeting for the public award of premiums. The Royal Institution of London, at its Friday evening meetings, calls frequently on mechanics for lectures,* explaining their arts and trades, and the improvements in them. These and similar efforts contribute to diffuse and to increase knowledge. If the results seem to be small, lost in the great stream of improvement which ever flows onward; yet in mingling with it, they impart at least some small motion to its mighty mass. The collision of mind with mind that takes place in these numerous associations, is of high importance; the tendency is to make men aware of their own deficiencies and to furnish a motive to supply them, to liberalize the feelings, to promote mutual confidence, and to produce *esprit de corps*. These results are of inestimable value in the aggregate.

Which of all these plans, devised by the intelligence of so many minds, for the *improvement of the useful arts, and of their cultivators*, have we followed out? What new paths have we opened? What success has attended our exertions? Voluntary associations for the improvement of agriculture, manufactures, and the arts, exist all over our country, not supported, it is true, by our great sovereign, the people, but by a few, who are either immediately or remotely interested, or who desire to advance the weal of their country. If the eyes of this most august sovereign might but be opened to the importance of fostering these institutions! If for the improvement of the mass, he would but contribute a little of what he lavishes in raising up the political princes of the land! In the olden time, the Commons of England gave every ninth sheep and every ninth fleece to their ruler, to enable him to wage war; now a large portion of *our* commons devote at least the ninth penny to King Party, to enable him to carry on the strife political. Would that they would spare the ninth part of this to put down ignorance and elevate virtue!

* The London reader will stare at this. Some person has been hoaxing the American Professor.—Ed. M. M.

NOTES AND NOTICES.

Mr. Stuckey's Filtering Process.—On May 11, the Earl of Radnor presented a petition from Mr. Stuckey, praying that the Lords would inquire into his mode of filtering water. His lordship pressed the subject upon the attention of Government, and upon the committee for promoting the health of large towns, and concluded by saying that Lord Brougham could bear testimony as to the great value and applicability of the process. Lord Brougham said that he had been present at an experiment with the model filter, which, although only five feet square, filtered thoroughly the New River water at the rate of upwards of two millions of gallons per day. He strongly concurred in recommending it to Government, and to the Committee on the health of large towns. Mr. Professor Phillips had given evidence of the efficacy of the filtration, which had the rare merit of getting rid of the dirt, which accumulating, produces malaria, and occasions great expense in all other systems of filtration.—*Globe.*

Dr. Johnson on Aerostation.—"The wings were finished, and on a morning appointed the maker appeared furnished for flight on a little promontory. He waved his pinions awhile to gather air, then leaped from his stand, and in an instant dropped into the lake. *His wings, which were of no use in the air, sustained him in the water*, and the prince drew him to land, half dead with terror and vexation."—*Rasselas.*

All-powerful Steam.—The British and North American Royal Mail steamer, *Hibernia*, Captain Judkins, arrived at Liverpool on Saturday last. She left Boston on the 16th instant, at one o'clock in the afternoon, and Halifax, where she stopped eleven hours, on the 18th, at three o'clo k in the afternoon. The passage from Halifax to Liverpool was performed in the unprecedentedly short space of 9 days and 12 hours, and the passage from Boston to Liverpool, including the stoppage of eleven hours at Halifax, in the equally unprecedentedly short space of 11 days and 12 hours, or in only 11 days' actual steaming! Her outward passage occupied 14 days.

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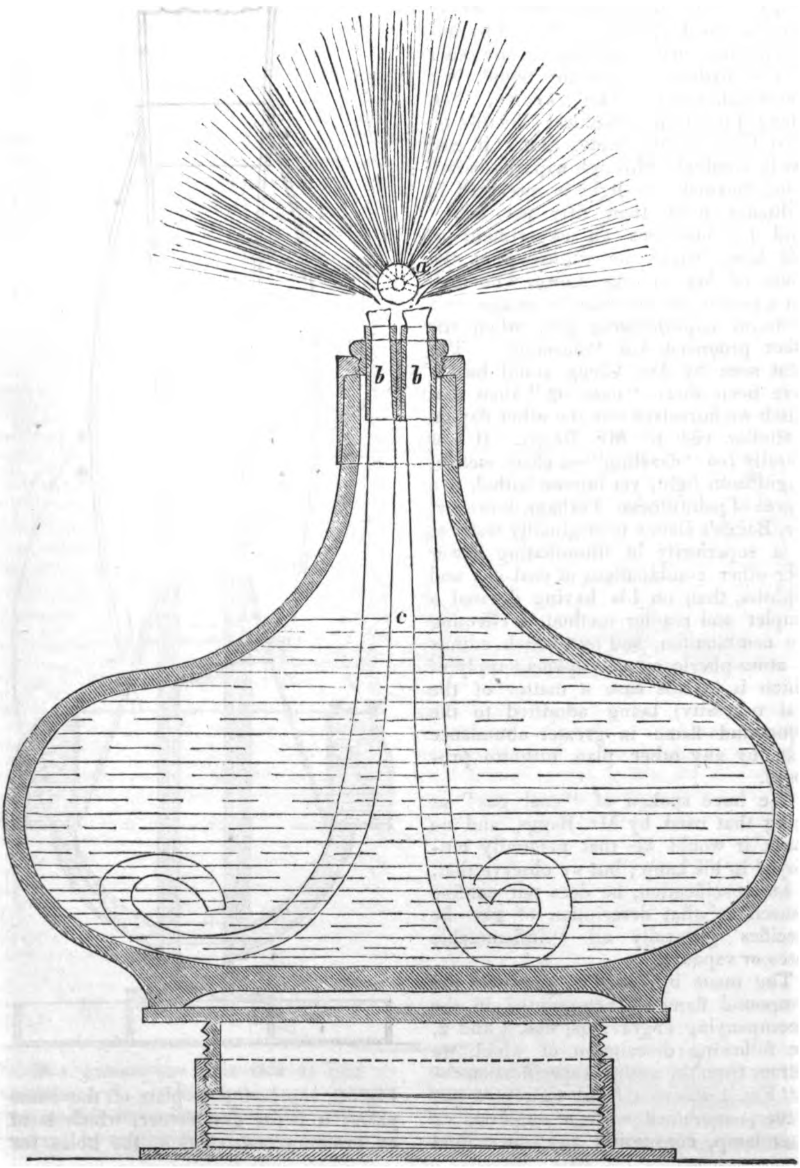
MR. BAGGS'S NEW LIGHT.

Fig. 1.



MR. BAGGS'S NEW LIGHT.

[Patent dated November 25, 1842; Specification enrolled May 25, 1843.]

The new light which forms the subject of the present patent is a compound product of coal gas and naphtha, or any other liquid substance which, like naphtha, "gives off smoke on being consumed." That the illuminating power of coal gas can be greatly increased by impregnating it with naphtha, or any other volatile hydro-carbonaceous liquid, is a fact which has been long known. Mr. Clegg, jun., in his Practical Treatise on Coal Gas, p. 200, states that "if coal gas be conducted through naphtha before being burned, the light is increased in brilliancy more than fifty per cent." And he mentions an experiment of this kind, which he witnessed at the house of Mr. George Lowe, who took out a patent two or three years ago for a mode of naphthalizing gas, when the effect produced was "dazzling." The light seen by Mr. Clegg could hardly have been more "dazzling" than that which we ourselves saw the other day on a similar visit to Mr. Baggs. It was literally *too* "dazzling"—a clear, steady, magnificent light, yet intense withal, to a degree of painfulness. Perhaps, however, Mr. Baggs's claims to originality rest less in a superiority in illuminating power over other combinations of coal gas and naphtha, than on his having devised a simpler and readier method of effecting the combination, and one which admits of atmospheric air (a copious supply of which is in this case a matter of the first necessity) being admitted to the compound flame in greater abundance than by any other plan hitherto proposed.

We have spoken of "coal gas" as being that used by Mr. Baggs, and no doubt it would be that generally employed in his lamp; but we observe that, in his specification, he does not confine himself to that description of gas—he specifies generally all "inflammable gases or vapours."

The mode by which he produces the compound flame is represented in the accompanying engravings, figs. 1 and 2, the following description of which we extract from the author's specification:—

"Fig. 1 shows a front view of a gas burner, combined with a naphtha, or other lamp, consuming any other fluid capable of giving off smoke in being consumed; this lamp is shown in section.

Fig. 3.

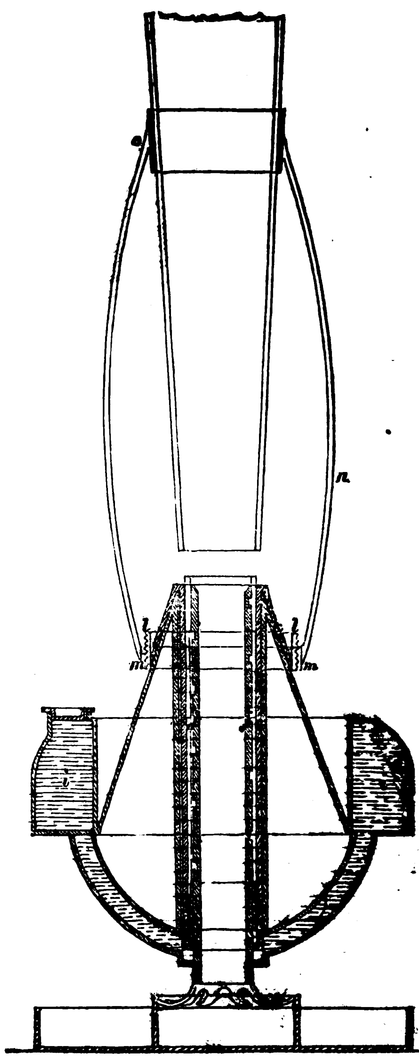


Fig. 2 represents a plan of the same parts; *a* is the gas burner, which is of an ordinary construction, the holes for

the jets of gas or vapour being in radial directions in a vertical plane; *b b*, are the wicks of the lamp for consuming naphtha, or other suitable fluid contained in the lamp *c*, which may be made of any convenient shape, depending on the locality in which it is to be placed, and there should be means of regulating the position of the burner of the lamp *c*, in respect to the burner *a*, in order that the greatest effect may be obtained in combining the flames of the burners *a* and *b*."

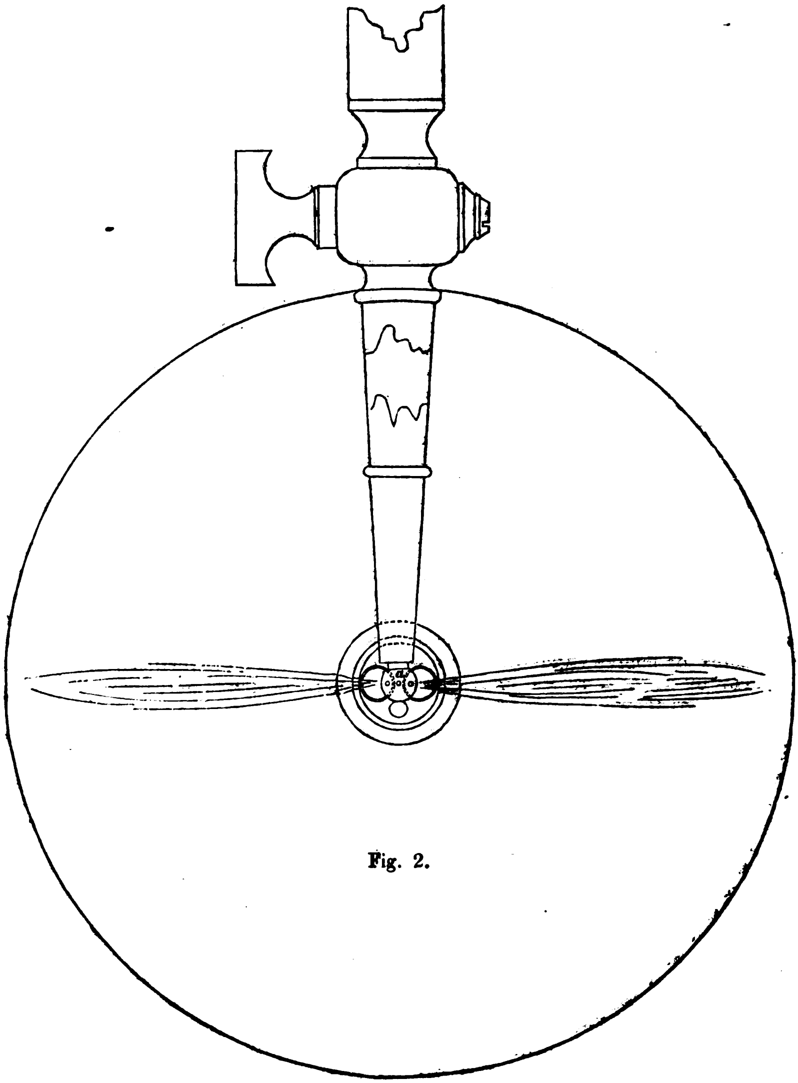


Fig. 2.

We cannot say that this is just as satisfactory a description as might reasonably have been desired. What is meant by saying that "there *should* be means of regulating the position of the burner of the lamp *c* in respect to the burner *a*, in order that the greatest effect may be obtained, in combining the flames

of the burners *a* and *b*." If there *should* be such means, and if the inventor knew of any such means, why were they not pointed out?

Mr. Baggs's patent covers also a new kind of glass chimney, which he considers more suitable to the burning of his compound flame than any other. It is represented in fig. 3, and thus described in his specification:

"Fig. 3 shows a section of a naphtha lamp combined with a conical chimney, the smaller diameter of the chimney being downwards, and the interior diameter of the lower end should be about the same diameter as the external diameter of the wick; and the chimney is to be supported at a position above the wick, so that the air rushing into the chimney may have a beneficial effect on the flame, and cause it to burn without smoke. *i* is the vessel to contain oil, or other suitable matter; and *j* the wick, which is moved up and down spirally, as is usual in argand burners; *k* is a conical frame, on which the gallery *l*, which carries the chimney, is placed as is shown. On the outer surface of this gallery is formed a male screw to receive the ring *m*, with a female screw; such ring having stems, *n n*, to support the glass chimney; such stems carrying a band or hoop, *o o*, into which the glass chimney is placed as is shown."

SUGGESTED IMPROVEMENTS IN THE PROPULSION OF BODIES THROUGH WATER—REPLY OF X. Y. Z. TO MR. CHEVERTON ON MR. PILBROW'S "DISCOVERY."

Sir,—Your ingenious correspondent Mr. Cheverton, in noticing the experiments described by me as a confirmation of Mr. Pilbrow's discovery, contends that the disk in the experiment I mentioned was larger than the diameter of the jet of water; that the results depended on that circumstance; and that had the disks been of the same dimensions, the results stated could not have taken place; and, therefore, that the idea suggested by me relative to improvements in paddle-wheels is not tenable. Whatever were the dimensions of the different parts of the apparatus made use of on the occasion mentioned, or what the proportion between the disk and the jet, or whether the jet, as you, Mr. Editor, suggest, fell perpendicularly, and not horizontally or in any other direction, I have not the means of ascertaining; but some experiments which I myself made, shortly after sending to you my first letter on the subject, and which I will now describe, satisfy me that the principle was a good one, and that important advantages would be likely to result from its practical application. I have not the least doubt that both you, Mr. Editor, and Mr. Cheverton entertain erroneous ideas as to the principle upon which these experiments, both with steam and water, are found to act.

The experiments described by Mr. Cheverton, in his former letter, required the flat disk to be larger than the jet, otherwise all the water would not strike it, and the full effect could not be had; but your correspondent cannot be serious in supposing the increased effect to have arisen in that case from the enlargement of the circle of water, notwithstanding the authority he has brought forward to support that view. Even if it had, the experiments with the hollow disk are of a totally different character; for the problem was not whether the flat or hollow disk, of equal area, was impelled by the water with a force greater than what was due to a given head of water, but whether the flat disk or the one with a rim had to present the greatest resistance to the jet; and for this purpose it could have made no difference in the result whether the jet was smaller in diameter than the disks, or whether it fell perpendicularly or flowed horizontally, or in any other direction. The comparison could be drawn equally well in *any* of these cases.

The experiment I proposed consisted in determining the tractive force necessary to draw two small floats in water, by means of a cross bar, to which they were attached by lines. The floats were of light wood, with a slip of lead nailed to the bottom of each to steady them, 3 inches square, and 9 inches long. The front of one was flat, and of the other also flat; but the latter had a raised rim round the edge, without increasing the area, and it was divided into nine small compartments by slips of wood, feather edged. I found that the line drawing these two floats by means of the cross bar could not be made fast to the centre of that bar, but required to be placed

nearer to that end of the bar to which the line from the float which had not the plane surface was fastened, so as to increase the leverage of the bar in favour of the other float, and make both to move through the water with an equal velocity, and keep the bar square. The leverage of the bar, under those circumstances, shows the difference of traction, or the resistance, or increase of resistance, given by the float which had not the plane surface.

This is an experiment your correspondent cannot have much trouble in testing, and he will find it conclusive. I found that the slower the floats were drawn the less necessity there was for running the tow line from the centre of the bar, and that the speed regulated the distance. It should be fastened from the centre, as might be expected. There can be very little doubt from Mr. Pilbrow's experiments that the increased effect does take place in his experiments. Why, then, dispute that point? I cannot well understand this, when at the same time Mr. Pilbrow's opponents have a sufficiently strong case by requiring it to be shown how such increase of power can be taken advantage of in practice.

I am, &c.

X. Y. Z.

[That a concave surface will catch more than a flat one is readily admitted; what the Editor denies, and others find it, with him, difficult to believe, is, that *the jet* acquires any *additional force* from the repellant surface (whatever the form of that surface may be), which is what Mr. Pilbrow and Scalpel affirm, and persist in maintaining. Perhaps we ought to qualify the word *persist*, for though they do not acknowledge themselves in the wrong, they do *not* persist in defending their error. They are silent only; thinking, possibly, silence in their case more eloquent than words, but at the same time forgetting that, next to the merit of successfully establishing a right principle, is that of candidly surrendering a wrong one.—Ed. M. M.]

THE AMERICAN EXCAVATING "GIANT."

Sir,—I see in the *Railway Journals* an account of an extraordinary excavating machine—a real "Giant"—which has been imported from America, and may be actually seen at work in the Brentwood cutting of the Eastern Counties Railway, doing such superhuman wonders that half the race of "navies" may thenceforth consider their "occupation gone." "The machine *is* made," quoth one would-be emphatic writer; "it *can* work admirably; it *must* come into use; and it *is* utterly futile to weep over the deprivation of employment to navigators."

Let us see. The machine, it is said, can "perform the labour per day, in getting and filling, of 100 men," and the proof is that it lifts and fills "nearly a cubic yard and a half of stiff clay in about the same space of time as a labourer would lift and fill a foot cubic." But a cubic yard and a half is equal to 40½ cubic feet only; so that, testing the assertion by the proof adduced, the pretended performance is at once reduced to 59½—nearly one half! Now to say that it can do the work of 59½ men is saying nothing, unless it could be also shown that it costs less than as many men would. The engine is worked by steam power, but what the amount of that power is, the "touters" of the "Giant" have thought it prudent to conceal. Is it of 40, or 50, or 100 h. p.? From a cursory glance at it I should say somewhere about 40. Now that a 40 h. p. steam-engine should do no more than the work of 59½ men, or even 100, or even twice 100, is anything but cause for exultation. If that is all it can do, the "navies" have nothing to fear. For, besides the cost of the steam-power, which will certainly not be less than that of an equivalent amount of manual power, some further not inconsiderable deductions must be made for interest on the price of the machine, loss from tear and wear, and the wages of the two or three men required to work it.

So much for the performances of the "Giant;" a word now as to the mechanical skill shown in its construction. So huge, clumsy, and multitudinous a combination of beams, shafts, posts, cylinders, pistons, levers, chains, wheels, pulleys, &c. &c., to accomplish a very small affair, I never before beheld. One can fancy a more instructive instance of the vanity of attempting to do by machinery what machinery is incapable of doing—for there might have been ingenuity in the attempt, and there is

none; but I defy any one to point me out an instance of more miserable failure. It is but a spade after all; a spade for a giant it may be—some "Briareus with a hundred arms;" but still a spade only, that can earn for its giant owner no more than is necessary for his decent maintenance.

I am, Sir,

Your constant reader,

PROBE.

THE AMERICAN COOL SWEATING PROCESS OF TANNING.

[From the *Franklin Journal* for February, 1843.]

It is a matter of much regret, that, at this moment, when every other art and manufacture has been benefited by the discoveries of science, the manufacture of leather seems to stand, to a great extent, unimproved and unchanged by the progress made in chemistry, and uninfluenced by the rapid march of other branches of art towards perfection. Old modes of procedure have, in every other department of the producing interest, been discarded, and the entire processes revolutionized by the light thrown upon them from the discoveries in chemical and mechanical science. Though the investigating chemist has endeavoured to improve the mode of manufacture, and much light has been shed upon that part of the process which he has examined, yet the tanner has done little or nothing to aid his investigations, being too generally content to follow the practices of his fathers, often erroneous, and founded upon false theory, or a mere hap-hazard method. It is true, that, in the mechanical processes much improvement has been made upon the modes practised by our forefathers. We may trace them from early antiquity, when the flail served to break the rough bark for soaking in the pit, down through the stone, crushing and breaking, by its revolution, the bark beneath it, to the adoption of the cast-iron mill propelled by steam, by water, or other powerful agent. The application of steam has been thought, by some, to aid materially in the extraction of the tannin; but that this is true, or that tanning with warm liquors, or with liquors containing tannin thus extracted, improves the quality of the leather, admits of a doubt. To these may be added various kinds and descriptions of reels, rolling machines, and other modes of lessening labour and expense, to describe all which, with the numerous attempted improvements, would require a volume. But it appears that these are all more mechanical improvements, highly valuable, it is true, as far as they go, originating in the desire of the tanner to lessen those expenses which were more obvious to his understanding than the equally important losses which he was sustaining by erroneous processes in the chemical department of his operations.

That the manufacture of leather should have made such slow progress, is rather surprising when we consider the vast utility and extensive use of the article in every department of civilized life. The Hon. Gideon Lee, in his lectures on tanning, has truly remarked that, "In point of necessity, few manufactures surpass it. Leather, indeed, seems to enter into the uses of every other trade, every family, every person; nor does it stop at the useful—a large portion of ornamental furniture, equipages and dress, admit and require this commodity, in some of its numerous forms. Whichever way we look or move, we cannot fail to see this indispensable article in use." Upon inquiry into the history of the progress of this art, we cannot find that any tolerably correct notion of the philosophy of tanning existed until within the last forty years. Prior to this, it was deemed a mere mechanical process, and the attention of chemists had never been turned to the investigation of the subject. That leather was a definite compound of the gelatine, and albumen of the hide with the tanning principle, was unknown and unsuspected. It is true that some improvements have originated in a more definite knowledge of the action of the substances concerned. Of the tanning, properly so called, it is not our purpose at present to speak; but will confine our attention to that part of the process connected with the preparation of the hide for combining most advantageously with the tannin; we allude to the liming and bating, or the unhairing and cleansing, preparatory to introduction to the liquor, which is a solution of the tanning principle. The mode extensively used in England, upon the Continent, and in the United States, is that of steeping the hides in a solution, or more properly a milk, of lime, in which they are allowed to remain from one to three or more weeks, according to the state of the weather and the texture of the hide, until they present the appearance which experience has taught is proof of the proper action of the lime. This has the effect to loosen the hair and epidermis of the skin, and render it easily removable by the after rubbing down, by means of a knife, upon a beam, or block. Another mode of producing the same result is that of suspending the hides in a close chamber, heated a little above the ordinary temperature of the atmosphere by a smouldering fire. In this case, the epidermis becomes loosened by incipient putrefaction. A so-called sweating process is in use in Germany, and by some

applied in this country; but it, as well as the preceding, is attended with much risk—so much so as to preclude their extensive adoption. By the last, the hides are laid in a pack, or pile, and covered with tan, or other imperfect conductor of heat, in order to confine the heat generated by the spontaneous decomposition of the gelatine, or other substance of the skin, and roots of the hair.

To the investigation of this very important part of the tanning process, chemists seem to have given little, or no attention; and the practical workman has derived from them no insight into the true nature of the operation, and, consequently, has not improved it to that extent which is desirable. The action of lime upon the texture of the skin, so far as the loosening of the hair is concerned, is not involved in much obscurity; but the other changes effected upon the hide, which remain permanent, and influence, to a considerable extent, the quality of the leather, have never been satisfactorily explained. Neither have the chemists yet been able to give any satisfactory elucidation of the mode of operation of the bate, (as technically termed,) which consists of a solution of the muriates of ammonia and soda, &c., from the excrements of pigeons and domestic fowls. That the muriates are decomposed by, and combine with the lime, rendering it more soluble; is most probably the true explanation of that part of the process; but how the fermentation produced affects the quality of the leather is not clear, unless we suppose that a large portion of the gelatine and albumen of the hide are removed. Though this is highly probable, yet we believe it is not generally admitted by tanners.

The Hon. Gideon Lee, in his lectures on tanning, remarks, "I believe much of the original gelatine of our hides is never combined with the tannin, but is wasted, actually extinguished, or incapacitated, or perhaps both, in the process of the manufacture; for I have not a doubt that, if it were possible to bring every particle of hide, the moment it is prepared for the handler, into conjunction with the tannin, as chemists are able to do with the solutions of both, the results would give nearly two hundred pounds (probably one hundred and eighty) of leather from one hundred pounds of perfectly dry hide, when cleansed from all extraneous appendages." "But, as this is impracticable —as we must retain the original organic form of the hide, in order to make leather of it—it becomes our business to devise and adopt such saving modes of process as will waste the least, and save the greatest, quantity of the gelatinous substance of the hide." No doubt a vast saving of the gelatinous parts, and, consequently, a much increased amount of leather, might be made by adopting new modes of preparing the hides for the liquors. Further, we can say with confidence, that such saving has been made, and the quantity of leather produced has very nearly approached that which chemists consider the greatest amount possible. "Saving," he truly remarks, "should be the order of the day," and we may add, that he who, by the application of scientific principles to the manufacture of leather, should thereby add to the value of the article produced, and, consequently, to the general comfort and wealth, should justly be considered a benefactor to his country. When we consider the immense amount which has been annually lost for ages, for all practicable purposes, we are appalled at the sum, and our surprise increases, that tanners have not busied themselves to lessen this immense drain upon their profits.

Among the evils of the old process may be enumerated that which arose from the energetic action of the agents made use of, and the extreme caution necessary to be observed in their application. By this process, still extensively used, the dry hides are subjected to the operation of the fulling stocks, which, by their powerful action upon the fibres, soften and extend their particles, causing them to move on each other, and, we believe, if long continued, opening the pores, and removing a considerable portion of the soluble matter of the hide, causing that "softness, limberness, and thinness," which is sometimes complained of in leather which has been otherwise well managed. A certain degree of softness appears to be absolutely necessary for the proper action of the lime and bate, and for the just incorporation of the tannin with the hide. Against the liming process a strong objection may be brought, in its injurious action upon the particles of gelatine and albumen of the hide. That a substance so powerful in its affinities, and capable of decomposing so rapidly most animal matter, should act with injurious effects upon the moist, porous substance of the softened hide, can scarcely be doubted by any who have had any practical experience on the subject. The effects this agent produces in expanding and stretching the fibres of the hide, thereby drawing them from their original position, and, consequently, weakening their texture, must be obvious— "swelling, as it does, the body of the hide to double its original thickness." "Every tanner knows that high-limed leather is loose, weighs light, and wears out quickly;" and may we not with much probability suppose, that its injurious effects are produced in a proportionate degree by the "low liming process?"

The evils resulting from the use of this agent are doubtless to be ascribed to its decomposition of the albuminous and gelatinous parts, and that thereby an amount of these substances is destroyed, of which we can form no adequate idea. Not only does the tanner thus lose those parts which would have combined and formed leather, but that which is formed is rendered less valuable, owing to its decreased solidity, toughness and porosity.

Without doubt, the injurious effects produced by liming are increased and heightened by the after process of bating, which is intended to extract the lime, and bring down the skin to its original thickness, by soaking or drenching, as before alluded to. The muriates, &c., in solution, which render the lime more soluble, and thus easily removed, carry off a portion of the glue, &c., and the fermentation induced by the decomposition of the animal matters of the bate, also materially assists in the destruction of these easily decomposed components of the hide. That a fermentation takes place, is proved by the rapid action of the bate in destroying the grain side of the skin, or hide, during the warm days of summer, if not properly attended, and suffered to proceed too far. Another objection which should not be passed over, lies in the extremely unpleasant scent arising from the putrefaction of animal matter, which is inseparably attached to the clothing and persons of the workmen engaged in this branch of the business.

The evils arising from the old, and still practised methods, being thus made sufficiently apparent to the understanding of every practical man, who has not already appreciated them and learned from sad experience their reality, we are prepared for the reception of a process which, to a great extent, in the estimation of those who have applied it, removes the difficulties under which the tanner has laboured. This is that which has been erroneously denominated the "cool sweating process for unhairing hides and skins," in contradistinction to that which is practised in Europe, and, to some extent, in this country, and is called the "warm sweating," and which has been before described. It will be remembered that the effects produced by the latter method, in loosening the hair, are due to the putrefaction engendered by their being placed in piles, or exposed to artificial heat, and that is attended with much risk.

The so-called "cool sweating process," and apparatus made use of, are thus described. First, a vault, or pit, should be prepared for the reception of the hides, which, for convenience sake, should be 12 feet long, 12 feet deep, and 10 feet wide. The walls may be built of stone, or a frame, and planked. There should be an alley, or vestibule, for entrance, not less than 6 feet long, having a door at each end, the outer one made double, and filled in with tan, to prevent the communication of warm dry air from without. A ventiduct, made of plank, 10 or 12 inches square, should extend from the centre of the bottom of the vaults, three or four rods therefrom, and placed not less than 4 feet below the surface of the ground. This serves both as a drain for discharging the water of the vault, and to admit damp cool air, to supply the place of that which has become rarefied, and thus keep up a current through the ventilator at top. The ridge of the roof may be level with the surface of the ground; on the ridge, and extending its whole length, set up two planks, edgewise, 2 inches apart. The space between these is to be left open, but cover the remainder of the roof with earth to the depth of not less than 3 feet. The covering of earth upon the vault and drain is to preserve a low temperature for the hides, so that they may unhair without tainting. Spring water should be conducted, either in pipes or logs, around the angles formed by the ceiling with the walls of the vault, from which water should be allowed to flow in small quantities, either forming a spray, or falling so as to raise a mist, or vapour, and saturate the atmosphere of the vault. The temperature of spring water is generally about 50° Fah. Water evaporating at all temperatures, it is plain that, if a constant supply be afforded, this evaporation, by requiring a large portion of heat, would keep the temperature of the vault nearly uniform. To suspend the hides in the pit, place three bars lengthwise, at equal distances, near the ceiling, with iron hooks, 2 or 3 inches apart, inserted therein. Soak the hides as usual for breaking, then hang them singly upon the hooks by the butt, spreading them fully open. In the course of a few days, when the hair begins to loosen upon the upper parts, take them down, raise the middle bar, and hang them by the other end until they will easily unhair. The hides should not be broken until they are taken from the vault, and ready to unhair. In a good vault, where the thermometer ranges from 44° to 56° Fahrenheit, which it should never exceed, and where there is a free circulation of *damp* air, hides generally require, for unhairing, from six to twelve days. When the temperature falls below 44°, the ventilator should be partially closed; and when it rises above 56°, *cold damp* air must be forced in, or an increased quantity of cold spring water may be thrown from a hose, or otherwise.

If this process is properly and carefully

conducted, hides will be received by the tanner, from the beamsman's hands, free from all extraneous matter, and retaining nearly all their gelatine, or glue, with the albuminous and fibrous matter of the organized hide. The action of the agents employed in the cool sweating process appears to be confined to the *surface* or *grain*, of the skin, expanding the outer portion, and softening the roots of the hair, thus rendering their extraction more easily effected. In opposition to some who, without due examination, have pronounced this a putrefactive process, and consider it as differing in no important particular from that formerly made use of, and which was attended with such imminent risk, we, after considerable experience and investigation, are brought to the conclusion that the effect produced by what is called the "cool sweating process," is due to the *softening* action of the vapour, and that it is a simple case of absorption and swelling of the tissues of the skin, and roots of the hair. Various circumstances combine to strengthen us in this opinion, the most obvious of which are the following, viz.: We believe it to be the opinion among chemists that the putrefactive fermentation, or that which is vulgarly called tainting, is always attended by the formation of ammonia, (spts. hartshorn, a substance readily perceived by the senses,) and that when this cannot be recognized in the vault, or chamber, in which the process is conducted, we are warranted in supposing it is not produced, and that, consequently, this fermentation does not take place. That the action of the vapour is confined to the surface of the hide, is proved by its increased weight, when prepared by this process, over that by liming, and the consequent gain of leather; for whereas, by the old liming method, thirty to forty per cent. gain upon the original weight of the dry hide was considered a good increase, now, by the cool sweating, a gain of from fifty to seventy, and even eighty, per cent. is often obtained—thus showing incontestably that a great amount of the softer portions of the hide, which were formerly lost, are now retained within it by this method of unhairing. This result would not to the same extent be produced, if the process was putrefactive, as thereby much of the substance must be removed, or brought into a condition to be acted upon by the solvents to which they are subjected. We may add, that those chemists who have attentively examined it, have pronounced it a simple case of absorption and softening.

The advantages which this process presents, must be apparent to the understanding of every unprejudiced practical tanner, who is at the same time acquainted with the chemical nature of the action of the substances used in his art. To the tanner, who believes that all the *glue* must be extracted from the hide in order to make good leather, this method would appear erroneous; but who, that has any knowledge of the composition of leather, so supposes? or who would consider the objection of such as worthy of regard?

The continuance of this method, where once adopted, is the best proof of its utility, and that it realizes, in practice, all that was expected of it. It is practised almost universally in the large tanneries of New York, Maine, New Hampshire, and, to some extent, in northern Pennsylvania.

THE ENGLISH-BUILT TURKISH STEAMER, "PEIKI FIGURET."

Sir,—Well knowing the deep and sincere interest you take upon all occasions in the success of any production or effort of science worthy of being laid before the public, and the readiness with which your pages are at all times open to record the proof of such production, in whatever branch of science it may appear, I am induced to offer a few remarks upon the trial of the new steamer, which made an excursion down the river on Monday last, and to request a place for them in your valued Journal.

The steamer in question (the *Peiki Figuret*) was built in our river for the Ottoman Steam Navigation Company, for the conveyance of passengers and the mails from Constantinople to the out-ports, by the eminent and justly celebrated builders, Messrs. Fletcher and Sons, of the Union Dock, Limehouse, from whose yard some of the fastest and first-rate steamers have been launched. The designs for the *Peiki Figuret* were furnished by Messrs. Retherdon and Carr, of Billiter-square, and do them great credit; the length between perpendiculars is 168 feet; beam, 26 feet 6 inches; depth of hold, 16 feet 6 inches; draught of water, 10 feet 6 inches; burthen, 568 tons, old measurement. She is fitted with a pair of beam-engines, by Messrs. Miller, Ravenhill, and Co., of the collective power of 190 horses. Of these engines it will be at once admitted by any one conversant with mechanical classification, that for chaste and proportionate arrangement and

disposition of the materials, for strength, compactness, firmness, and excellence of workmanship, it is not possible to look upon any thing to surpass them. Their efficacy in propelling is fully equal to their appearance, as is fully established by the following particulars :—

At about one o'clock on Monday, the Turkish Embassy at the British court, *en suite ;* the secretary to the Pacha of Egypt, and a very numerous party of scientific gentlemen, English and foreign, went on board the *Pieki Figuret*, at Blackwall, for an excursion trial. At about 2 o'clock high water, she started for Gravesend, and after performing the greater part of the distance, turned round to try her speed against the tide, and again took the tide to Gravesend, returning, about 6 o'clock, to the Brunswick Hotel Pier. During the progress of the runs with and against the stream, full opportunity was afforded to all present on board for observing the excellence of the machinery, and the sailing qualities of this fine steam ship. The engines moved in the most smooth, easy, and beautiful manner, making 24 to 25 strokes per minute, and, going with the tide 15 miles, and against tide 12 miles per hour, a speed which could hardly be expected, and has, heretofore, seldom, if ever, been accomplished by sea steamers. Upon the return of the vessel, the most unbounded satisfaction was felt and expressed by his excellency the ambassador, and the whole of the company, at the performances they had witnessed.

We have here another proof, Mr. Editor, if proof were wanting, that it is upon the banks of the Thames, the proudest and best combined productions in steam-ship and steam-engine making are to be found. By giving these few observations a place in your next Journal, you will oblige your constant reader, and occasional contributor.

JUSTICE.

June 1, 1843.

SIR WILLIAM BURNETT'S ANTI-DRY ROT PROCESS.

The machinery which has been recently established at Woolwich dockyard for the rapid impregnation of timber, cordage, canvass, &c., with Sir William Burnett's compound for preserving them from dry rot, mildew, or moth, has been found to answer very well. It consists of an exhausting and a forcing pump. By the former the air is exhausted from the pit, which is sufficiently capacious to hold 20 loads of timber, and as soon as there is a perfect vacuum, the other pump forces the compound into the pit, and the timber, &c., become thoroughly impregnated with it. However nautical men may have formerly questioned the utility of submitting the sails and rigging of a ship to this solution, there is now not a single officer in the service but admits that its benefits are unquestionable. For the unfortunate Niger expedition, the sails, awnings, &c., of the Wilberforce and the other vessels were all subjected to the preservative process, and the officers state that during the rainy season, when there was so much sickness on board, the sails were frequently rolled up to the yards for many days together, without an opportunity of airing or drying them, and but for the composition they would have rotted from the yards, whereas on the return of the Wilberforce to England they were in as good and serviceable a condition as when the vessel left on her ill-fated mission. Captain G. F. Gordon, when in command of the Devastation steam-frigate, had only one sail on board that had been submitted to the preparation, and after a trial of three months' incessant wet weather, this was the only sail on board that was not damaged, all the others, notwithstanding every precaution was taken to prevent it, had become more or less mildewed. From these and numerous other representations of a similar nature, the Lords of the Admiralty have resolved to introduce the preserved timber, sails, and cordage into general use in the navy, and Plymouth and Chatham Dockyards are to be fitted with a similar apparatus for preparing them to that now in use here.—*Woolwich Correspondent of the Times.*

[The difference between Kyan's process and that of Sir William Burnett is, that the former employs a solution of sublimate of mercury, and the latter a solution of chloride of zink.]

PRODUCTION AND TRANSMISSION OF SOUND IN WATER.

[Translated for the *Mechanics' Magazine* from *Jobard's Bulletin du Musée de l'Industrie.*]

It has been a question among modern philosophers, whether it is possible to ascertain the depth of seas and rivers by the time

which sound takes to reach from the bottom to the top. In 1826, Mr. Daniel Collardon was able to transmit sound, notwithstanding the noise of the waves, to a distance of 13,500 metres, (14,625 English yards). Some experiments made in America by Professor Bonnycastle, of the Virginia University, at the request of the Admiralty, gave an average, under similar circumstances, of 3,000 metres (3,025 yards) only. So great a difference induced Mr. Collardon to renew his experiments in the Lake of Geneva. The results of this gentleman's investigations were communicated to the French Academy of Sciences in a report full of curious and interesting facts, and from this paper we extract the following details:—

When you listen at a short distance to the sound of a blow made upon a sonorous body partly immersed in the water, two distinct sounds are heard, coming from the water and the air; the first, through the water, is shorter and duller than the second, transmitted by the air. But as the distance is increased, the ratio of the two intensities varies, and at a given distance, the sound conveyed by the water is much more intense than that by the air; and, by further increasing the distance, sound can be distinctly heard in the water, when none whatever is discoverable in the air, even when there is a perfect calm, and in the silence of night. It would be difficult at present to assign any limit to the distance to which sound can be propagated, for Mr. Collardon has constructed an apparatus, the amplifying powers of which are double that of the one he used when sound was heard at the distance of 13,500 metres, and he assures the Academy of being able greatly to increase the power of the new apparatus.

Mr. Collardon's instrument consists of a gong, weighing about a kilogramme ($5\frac{1}{2}$ drams English) with clockwork attached; a hammer, put in motion by the clockwork, strikes the gong, as it is liberated by a spring, which has one constant force of tension. He uses also a small musical box, which plays under the water, either enclosed in a case, or in a small diving-bell. The learned experimenter has discovered, among other facts, that sharp sounds are more easily heard in the water at a great distance, than grave ones. Vases, made of very thin metallic laminæ, are the most appropriate acoustic conductors for such experimental purposes, but all solid bodies partly immersed in the water, will, by placing the head against them, convey any sound, transmitted through the water, to the ear.

When a sonorous body is made to vibrate in water, its vibrations, far from coming to a speedy termination, continue for a considerable time, even when there is little difference between the density of that body and that of the water; for example, when a glass bell, of about 6 inches aperture, is made to vibrate by means of a blow in the water, it will be found that after the lapse of one second the vibrations will still continue, although no sound is perceptible; for if the bell be then taken out of the water, a very distinct sound is instantly heard. A large metal bell, entirely submerged, when struck, transmits a sound which lasts several seconds; and if a bar, held in the hand, be plunged into the water, near the bell, a very sharp vibratory movement will be felt, transmitted, of course, by the water to the bar. The tones of the voice can be transmitted to a considerable distance under water; but if the speaker be placed under a diving-bell, confused and undistinguishable sounds only are heard, at the distance of a few yards.

The percussive shocks of a water-fall, or of the paddles of a steam-boat of 100 horses' power, and even more, produce but a slight and confused noise, a sort of rumbling, at about 50 yards distance; at a thousand, no sound whatever can be heard. The wheels of a steam-boat produce, under water, a sound similar to the humming of a bee. Mr. Collardon infers from these experiments, that it is altogether a vulgar error to suppose that steam-boats have been the cause of driving fish away from rivers. Although the sounds produced by Mr. Collardon's apparatus, and propagated through the water, are briefer than those through the air, it is easy, notwithstanding, to recognize not only the degree of acuteness they possess, and their musical value, but even the quality of the sounding body. The noise caused by the rattling of a chain is so easily distinguishable, that you can tell in this way when a ship at 300 or 400 yards off is heaving her anchor. In the case of a maritime war, this fact might be turned to account. From other experiments made on the lake of Geneva, Mr. Collardon feels certain that a correspondence might be carried on under the water at a distance of some hundred thousand metres, by means of sounding bodies of great power, and a well-arranged acoustic apparatus.

The noise of waves does not prevent one from distinguishing blows struck on a bell, providing the construction of the instrument be such, that the waves will glide over its surface, without directly buffeting against it. Mr. Collardon attributes the inferior results obtained by Professor Bonnycastle, to a defect of this sort in the shape of his apparatus. At a distance of 25,000 metres (2710 yards English) every blow given on a bell can be distinctly heard. After all, however, Mr. Collardon, with commendable candour, acknowledges that sufficient expe-

riments have not yet been made to enable us to decide as to the practicability of measuring by this means the depth of seas and rivers.

THE GOLD MINES OF SIBERIA.

Before the year 1829, no gold was found in this part of Siberia, and, in fact, very little to the east of the Ural. In that year, a merchant at Tomsk, of the name of Popof, who was already possessed of a very considerable fortune, heard accidentally that a deserter, concealed in the woods, 150 versts east of the town, had found gold in the sands. He was an old man, and had a daughter, through whose means Popof discovered the place where her father had been digging, and immediately got a grant of the district. At first he was not very successful, the produce being only about half a zolotnik to 100 puds of sand washed. He then changed the theatre of his speculations, and removed his establishment to the northward, 1,600 versts north of Tobolsk, and north-west of Berézof. Here he found gold, but not in great quantities; and as the soil there is constantly frozen, the expense was very great; and all the necessaries of life extremely dear, no houses, and few workmen to be obtained. After having spent in all 63,000 roubles, he returned to his former field of operations, and, at the time of his death, in 1832, had succeeded in amassing four or five puds of gold annually. But, before he did this, he had searched in 300 different spots in the neighbourhood of Tomsk. A short time previous to his death, he is said to have lent to Mr. Astoschéf, of whom we have spoken, 40,000 roubles to begin his researches with. About the same period, came a rich merchant from Ekaterinburg, of the name of Riazánof, with a capital of 200,000 roubles to embark in the same speculation, and spent the whole of it without finding any gold. At last he fell in with a rich vein near the small river Kundustnik, of which Mr. Astoschéf gained intelligence, and made his application for the ground, so as to deprive the other of his lawful property, after so much time and money had been thrown away, before he was lucky enough to hit upon the treasure. A lawsuit on the subject was the consequence; but Riazánof, finding that his rival had too much protection, and that he should probably lose his action, saw there was nothing for it but coming to a compromise with him. The little river near which they had commenced operations, is about 100 versts in length; and they agreed to divide it. The speculation turned out well; the produce being a zolotnik to the hundred pud, or double what Popof had found. After this they formed a company, together with several of the first personages at Petersburgh, as it is said, the management, of course, being with the former, and the latter being what we call sleeping partners, except that their capital and influence, if required, made them very desirable associates. The Emperor is reported to have heard of this confederation, and to have hinted to some of the parties that it was contrary to law for them to be concerned in such an enterprise; and, in consequence, they sold their shares to Mr. Astoschéf, who is now a *millionaire.*—*Cotterell's Recollections of Siberia.*

The following additional particulars are extracted from a paper, read before the French Academy of Sciences on the 15th May last, "on the progressive increase of the results obtained from the operations on the auriferous sand of Siberia." The produce has been as follows:—

	Pouds of gold.		Pouds of gold.		Pouds of gold.
1830 ...	5	1835 ...	93	1839 ...	183
1831 ...	10	1836 ...	105	1840 ...	255
1832 ...	21	1837 ...	132	1841 ...	358
1833 ...	36	1838 ...	163	1842 ...	631
1834 ...	65				

and, according to all probability, the result of 1843 will show a great increase on that of 1842. The workmen employed in the extraction of the gold are almost exclusively convicts, of whom there were not less than 11,000 in Eastern Siberia in 1842. They are allowed the proceeds of one day in the week for themselves, but they are not permitted to dispose of the gold as they please. They are bound, on the contrary, to sell it to the persons who hold the privilege of the extraction, and are, consequently, paid less than its value.

KINGSTOWN AND DALKEY ATMOSPHERIC RAILWAY—PROGRESS OF THE WORKS.

The scene of the present experiment is a portion of the tramroad laid down for the purpose of conveying granite from the quarries of Dalkey for the construction of the magnificent harbour of Kingstown, but as the quantity of stone which has been required for several years past has been comparatively trifling, and annually decreasing, only one line of trams has been used; and the Dublin and Kingstown Railway Company having been empowered by their Act of Incorporation in 1831 to purchase the road, on the completion of the harbour works, with the consent of the Commissioners and of the Lord Lieutenant of Ireland, they opened a negotiation for the purchase of one-half the road—or a single line—and the necessary consent having been obtained, the

purchase was made, and the works were commenced in the month of October last.

Although the Company were empowered to purchase the tramroad, and afterwards to use it "for such purposes and in such manner as they might think proper," they had no power to interfere with the levels of the existing roads between Kingstown and Dalkey, of which there are no fewer than six, in a length of a mile and three-quarters, and all of which are crossed by the tram-road *on the level*.

As it would have been manifestly attended with inconvenience, and possibly with some danger, to attempt to cross those roads on the level, by the atmospheric railway, the directors at once determined to construct this latter in such an excavation as would enable them to pass under all the intervening roads without any alteration in their levels, and as the greater part of this excavation has been in granite rock of a peculiarly intractable character, the work has necessarily proceeded but slowly, and an alteration from the original plan, which has been lately determined on, by which the atmospheric line would be connected with the Dublin and Kingstown railway by a short tunnel (also in granite), has caused a further delay at the Kingstown end of the line.

Notwithstanding these and some other delays, we are now happy to state, that with the exception of the tunnel, and about 300 yards of rock cutting connected with it, the entire excavation up to Dalkey is finished, and with but little exception, ballasted; more than one half the rails are laid, and upwards of 800 yards of the main pipe are put down.

The engine-house is completed, and the engine and boilers are on the premises; and we understand that it is expected to have the steam up, and the engine and air-pump in motion, early in July.

The road rises from Kingstown to within 400 yards of the terminus at the rate of 1 in 115, and thence to Dalkey at the rate of 1 in 57. The carriages are to be drawn up by the atmospheric pressure, and are to return by gravity; and thus the sharp incline at the Dalkey end will serve the double purpose of starting and of stopping the train.

A friend of ours, who has, within the last few days, passed over the line, was much struck with the extreme sharpness of some of the curves. There are three of those within little more than half a mile, which vary from 570 feet to 700 feet radius; and as there is no part of the road straight for half a mile, we consider that it is quite impossible that the maximum of velocity of which the principle may be susceptible, can be obtained here; indeed, on this point, the Dalkey line cannot be deemed a sufficient trial.

The pumping engine, which is on the expansive condensing principle, is, we believe, what is called a "direct action engine." It has no beam, but the crank-shaft is immediately over, and directly connected with, the piston. The cylinder is 34½ inches diameter, with a stroke of 5 feet 6 inches. The steam is to be admitted at a pressure of 40lbs. per inch, (above the atmosphere,) and cut off at one-fourth of the stroke, and afterwards condensed, making 24 strokes per minute. The patentees call it 100 horses' power; according to Professor Barlow's formula it would be 201 horses' power.

The boilers (of which there are three) are a modification of those now generally in use in Cornwall; they are 4 feet 3 inches diameter, and 38 feet long.

It has been objected by many persons that the power of this engine is quite disproportionate to the length of the road, (1¾ miles,) and the probable weight of the load (about 30 tons.) Two things, however, appear to be omitted in this consideration, namely, the average inclination of the greatest portion of the road, 1 in 110, by which the resistance of the load is increased in the proportion of 4 to 1; and, secondly, the speed which is purposed to be obtained, and which, we understand, is to be 50 miles per hour.

Notwithstanding the great nominal power of this engine, its consumption of steam, worked as we have already described, will be found to be much less than that of one of the small locomotives on the Dublin and Kingstown line, the cylinders of which are only 12 inches diameter, and 18 inches stroke, when moving at the rate of 30 miles an hour, with the usual pressure of 50 lbs. to the inch. If in this latter case the pressure on the piston be 50lbs. during the entire of the stroke, the consumption of the fixed engine, as compared with the locomotive, is stated to be as 100 to 237. We have, however, some doubts that the pressure is *uniform* in the locomotive, but even making an ample allowance on this account, the comparison is extremely striking, and will attract much attention.

Strange to say, the *length* of the road to be worked is not a very important element in the power of the engine required to move a given weight at a given velocity. If there were no leakage, the engine would move the same weight at the same speed without reference to distance, but it must be at work a proportionately longer time, first in producing the vacuum, and secondly, in moving the load the greater distance—the traction *power* depending on the diameter of the main pipe, and the amount of rarefaction—the *speed* depending on the velocity with which the column of rarefied air in front of the piston is pumped out.

At present we believe there are not sufficient data to determine what the amount of the leakage may be. It is, however, manifestly proportionate, both to the length of the main pipe, and the time which may be occupied in producing the vacuum, and that of the train performing its journey; the sum of these quantities represents the *additional* power required for working a longer line. Further experiments must determine what they really amount to, but we have heard it stated on very high authority, that the engine now being erected at Dalkey would be amply sufficient to move the required load at the required velocity from Dublin to Dalkey, (7¾ miles,) instead of from Kingstown (1¾ miles.) —*Railway Times.*

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

JOHN RAND, OF HOWLAND-STREET, ARTIST, *for improvements in making and closing metallic collapsable vessels.* Patent dated September 29, 1842; Specification enrolled March 29, 1843.

The collapsable metal tube for holding colours, invented by Mr. Rand, and now in general use among artists, is one of the most valuable presents ever made by the Useful to the Fine arts. The improvements comprehended under the present patent consist, *firstly*, in punching out (by dies) the thin metal of which the collapsable vessel is formed, "with a short neck or nozzle" attached to it; and, *secondly*, in making a screw on that neck or nozzle, with a screw cap to fit, whereby the vessel will be less liable to leakage. The patentee speaks throughout his specification of using "thin *metal* tin." Whether there is anything peculiar in the quality of the tin employed, covered by this singular phraseology we do not know. Is there any such thing as *vegetable* tin?

SAMUEL DOTCHIN, OF MYRTLE-STREET, HOXTON, JEWELLER, *for improvements in paving, or covering and constructing roads, ways, and other surfaces.* (Communicated by his son Samuel Dolchin, jun., recently deceased.) Patent dated October 13, 1842; Specification enrolled April 13, 1843.

The blocks, according to the present plan of wooden paving, are to be six-sided, as those first introduced by Mr. Stead were; but instead of these sides being perpendicular to the top and bottom surfaces, they are to be inclined thereto, in alternately opposite directions, "whereby each block may support, and be supported by, surrounding blocks;" and whereby, also, there will be many "angular openings left in the pavement, which may be filled with asphalte, with grit, or other material or materials."

JAMES PALMER BUDD, OF THE YSTALYFERA IRON WORKS, SWANSEA, *for improvements in the manufacture of iron.* Patent dated October 20, 1842; Specification enrolled April 20, 1843.

Mr. Budd's improvements have been already very fully described in our journal. (See No. 1010.) His process of manufacturing iron, as contradistinguished from Nelson's and Crane's processes, may be called the *cold anthracite blast.* The points of novelty to which he lays claim are these.

"*First*, the application of anthracite or stone coal, combined with a blast of atmospheric air, in the natural or unheated state, maintained at a pressure or *pillar* of upwards of 2½ lbs. on the square inch, in the smelting or manufacture of iron from iron stone, mine, or ore.

"*Secondly*, the application of anthracite or stone coal, combined with the use of water tuyeres, and with a blast of atmospheric air in the natural or unheated state, in the smelting or manufacturing of iron from ironstone, mine, or ore.

"*Thirdly*, the application of anthracite or stone coal, in combination with four or more tuyeres, and a blast of atmospheric air in the natural or unheated state."

We have pointed out by Italics to the observation of the reader the phrase "pressure or *pillar*." In a dozen other places of the specification, (*teste* Repertory,) the patentee uses the same word *pillar*. We have "*pillar* of blast," "less *pillar*," high *pillar*," &c. Is this Welsh for pressure—as one may say *tweer* (tuyere) or *pipe*—or what is it?

JOHN MULLINS, OF BATTERSEA, SURREY, SURGEON, *for certain improvements in making oxides of metals, in separating silver and other metals from their compounds with other metals, and in making white lead, sugar of lead, and other salts of lead, and salts of other metals.* Patent dated October 27, 1842; Specification enrolled April 27, 1843.

Mr. Mullin's improvements are six in number.

First, he produces oxides of lead and other metals by forcing currents of atmospheric air, or oxygen gas, through masses of the metal in a melted state, "heated to the temperature of their respective points of oxidation," and then skimming off the oxides from the surface.

Second, to make white lead he exposes the oxide of lead obtained by the preceding process, which is stated to be much superior to the ordinary litharge and vitrified massicot of commerce, to the vapours of vinegar and carbonic acid gas. Or,

Third, he exposes a solution of acetate of lead, or other suitable salt of lead, made from "the oxide obtained as aforesaid," to an atmosphere of carbonic acid gas. We quote at length the patentee's description of the mode in which this is effected; it is new, ingenious, and we think likely to answer well.

"In chambers or large jars of earthenware, or other material, are suspended several large sponges, which are supported in the jars by strings of worsted, so as not to touch the sides of the jar, or one another. Having made a saturated, filtered, and neutral solution of acetate of lead, or of other suitable salt of lead, from the oxide obtained as aforesaid, and placed this solution in a vessel above the top of the jars, and having moistened slightly the sponges with the solution, and also the worsted strings suspending them, the strings are then made to dip into the solution contained in the vessel above the jars, and, by the power of capillary attraction, the sponges are kept constantly moist by a supply of the solution descending down the worsted strings; and the supply can be regulated at pleasure by the size of the strings or otherwise. Evaporation is continually going on, and crops of salts of lead are formed on the surface of the sponges. The jars are made to communicate with a gas-holder, or other reservoir, containing carbonic acid gas, which gas is made to fill the jars in order that the sponges may be surrounded with an atmosphere of carbonic acid gas. By the action of the gas the salt of lead on the sponges is readily converted into ceruse, assisted probably by the decomposition of the acid of the original solution. When it has been ascertained that a sufficient quantity of the ceruse has been formed, the sponges are removed and washed in a vessel of pure water; and if the sponges contain any undecomposed soluble salt of lead, which is generally the case, the water dissolves it; but the ceruse falls to the bottom on the water remaining at rest. The water is to be re-used for forming the solution when decanted from the precipitated ceruse. The sponges are then replaced as before, and the process continues."

Fourth, he employs common soot to deoxidize his oxide of lead, and generally for the reduction of all metals from their ores or oxide.

Fifth, when a mass of melted lead, treated by the process just described, contains any silver, the silver, being less oxidizable than the lead, accumulates at the bottom of the pot, whence it is drawn off occasionally to be farther purified and separated.

And *sixth*, to separate iron, the oxides are discharged down a shoot, fixed at an angle of about 30°, formed of wood, or some other non-conducting material, from the bottom of which the poles of a number of magnets project upwards, and to which a slow, lateral, sieve-like motion is given by machinery; the magnets attract and retain the iron, and the oxides pass free.

Richard Bevan, of Liverpool, *for certain arrangements connected with the circulation of steam employed in pipes or tubes for producing heat, and the application of such arrangements to various purposes*.—Patent Sealed November 5, 1842; Specification enrolled May 3, 1843.

The "arrangements" of the present patentee consist in heating by "a pipe or system of pipes of small diameter laid at the bottom of the vessel (containing the liquid required to be heated) or coiled about in any condensed manner, so as to afford a large extent of surface to the liquid," and laying the same with "a small continuous inclination downwards, so as to insure the immediate return of all water produced by the condensation of the steam into the boiler." Mr. Bevan seems, evidently, not to be aware of what is already commonly done in this way. His claim is to "the arrangement of tubes, whereby the circulation of steam leaving the boiler, and of the water of that steam returning to the boiler to keep up continuously the heat of condensation being employed in heating, boiling down, and evaporating, as above described."

William Hancock, Jun., of Amwell-street, Gentleman, *for certain improvements in bands, straps, and cords for driving machinery, and other mechanical purposes*.—Patent dated December 3, 1842; Specification enrolled June 3, 1843.

These improvements consist in making bands, straps, and cords for the driving of machinery, and other mechanical purposes, of the several varieties following:

First, to make a band or strap, (meaning thereby a flat band or strap,) which will be so flexible as to bend in all directions without rupture, and at the same time be stronger than any other flexible band or strap now in use, the patentee takes two strips of animal hide, or leather, or woollen cloth, or any other suitable material, and of any required breadth, and lays between them thin veneers of ashwood, lancewood, or any other species of wood possessing flexibility and toughness, or sheets of canvas, or sheets of strong hempen sail-cloth, or sheets of vellum or parchment, and unites the whole firmly together by means of a solution of India rubber, or any other strong cement, and by means, also, of an edge-binding, either of metal rivets, or thread, or wire stitching.

Second, he makes a flat band or strap,

having more or less the properties aforesaid, by substituting for the broad veneers and sheets before directed to be interposed between the outer folds of the band or strap, thin strands of leather, or India rubber, or vellum, or parchment, or whalebone, or cane, or catgut, (either round, as usual, or flattened by mechanical pressure,) or cocoa-nut fibre, or whipcord, or any other similarly flexible and strong material, laid either in straight, or angular, or curvilineal lines, and at any suitable distances from one another, and by uniting the whole firmly together, in manner before described.

Third, he makes flat bands and straps, possessing like properties to those before described, by interposing between the two outer folds (of whatever material the same may consist) slips of flat metal, or flat metal rings, or perforated metal plates, laid in any direction, and either close to one another, or at suitable distances apart, and binding the whole together by means of thread or wire carried through and through the band o strap, or by any other equivalent means. And

Fourth, the better to adapt catgut bands and cords, as also whipcord, to various mechanical purposes, for which, from their ordinary round form, they are unfitted, the patentee passes them through a flatting mill, and reduces them to any degree of flatness desired.

NOTES AND NOTICES.

Health of Towns.—Mr. Mackinnon has given notice of his intention to move the appointment of a select committee, to consider and report on the best means for the prevention of this great evil. If the committee is granted, it will but furnish another opportunity for contentious display to all the Smoke Doctors of the country. But there is no need of any committee; the reality of the grievance, and the perfect practicability of removing it, have been proved over and over again. The honourable member would have done better, had he brought in a compulsory bill at once.

Bothway's Iron Blocks.—An experiment has been made in Plymouth dock-yard, to try the comparative strength of Mr. Bothway's single metal blocks against the rope it is calculated to take, viz., a 3-inch one. A rope of that size was rove in the block, and one end brought to a windlass, and hove on until it broke. A 3½ inch was then tried; though larger than required for such a block, this also gave way; and the last is considered by practical men fully equal to the powers of an 8 or 9-inch block. The iron blocks have also another great recommendation in doing away with the rope strappings, as many serious accidents have occurred by their breaking.

Submarine Telescope.—Among the many important inventions of the age, none is likely to equal that of the submarine telescope, a description of which we find in the American *Mechanic*. This telescope is the invention of a lady, Mrs. Sarah P. Mathers, and by means of it a person is enabled to examine the bottoms of rivers, bays, lakes, and other deep waters, from the surface. The water is perfectly illuminated by it, and thus becomes perceptibly clear and distinct, as though air instead of water intervened. Experiments have fully tested the practical utility of this telescope; but since submitting it to these tests, the fair inventress is said to have made an improvement, by means of which, when standing on the deck of a vessel, we can examine every part of the hull as distinctly as we can see ourselves in a mirror. And this is accomplished by the application of a well-known principle—that of placing mirrors or reflectors within the telescope, by means of which a side light reflects, and shows the bottom of the vessel perfectly plain. We agree with the Editor of the American *Mechanic*, "that this invention should be at once applied to remove the obstructions in the Mississippi and other rivers, and for the discovery of those unfortunate boats, and the recovery of the imperishable parts of the cargoes which have been almost daily lost there, and amount to many millions of dollars per annum." Another advantage this telescope affords, is its illuminating turbid or "rily" water—no matter how turbid—as effectually as though it was clear as crystal. A pin has been distinctly seen in the muddy bottom of our bay, on a windy day, at the depth of two-and-twenty feet! The object once discovered and illuminated, there needs no invention to raise it to the surface.—*American paper.*—We inserted a notice of this instrument some time ago, and then mentioned the prior claims of our ingenious friend and correspondent Mr. Steele to its invention.—Ed. M. M.

Captain Norton's Lotus Floating Breakwater.—On a lake or pond where the lotus grows, Captain Norton had observed, that when there was a strong breeze and waves on one side, on the other, the water was comparatively smooth, resulting from the wind having no hold on the broad expanse of lotus leaves. He had also observed, after a storm at sea, the solid timbers of a wrecked vessel splintered in pieces by being driven against the shore, while a wicker basket escaped uninjured. These two results suggested the idea of constructing a floating breakwater of osiers, according to the singularly ingenious model in the Polytechnic Institution, the expense of which would be trifling compared with others.—*Polytechnic Journal.*

Mineral Water Bottles.—A paper on this subject by M. Beaude was recently read at the French Academy of Sciences. For some time past there have been several complaints as to the quality of the Eau de Vichy, sold in bottles of this description, and the deterioration was supposed to have been caused by the decomposition by the contents of the substances of which the vessels in which it is contained are composed. M. Beaude states that he has analyzed the waters contained in earthenware bottles, and has found no trace of the decomposition which was supposed to exist. He concludes that these bottles are quite as good for the purpose for which they are used as glass. This opinion is in opposition to that of M. Rognetta, who asserts that several kinds of mineral waters, which are sold in earthenware bottles, are deteriorated by the reaction of the mineral elements of the water upon those of the bottle, the mixture of the produce of this reaction in the liquid, and the mechanical infiltration of the liquid in the pores of the bottle. He concludes that it is improper to send mineral waters from the sources which supply them in any other way than glass bottles of the best quality.

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MR. ROBERTS'S IMPROVED GALVANIC BLASTING APPARATUS.

Fig. 1.

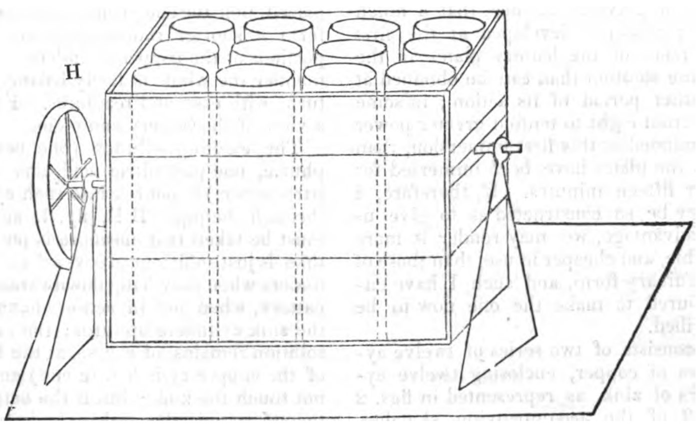


Fig. 2.

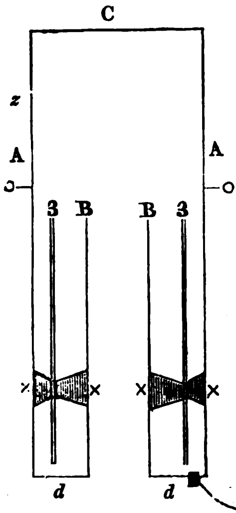


Fig. 3.

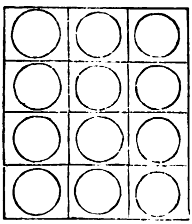
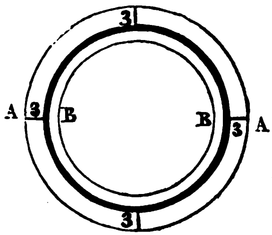


Fig. 4.



MR. ROBERTS'S IMPROVED GALVANIC BLASTING APPARATUS.

SIR,—I have lately contrived a new arrangement of galvanic battery for blasting rocks, and as it has been found far superior for this purpose to those I have before contrived, I send you a description of it for the benefit of those of your readers who may wish to employ electricity in blasting. It is a fact well known to those who have experimented much in galvanic science, that a much greater power is developed at the first immersion of the battery plates in the exciting solution than can be obtained at any other period of its action; in some cases from eight to tenfold greater power is circulated at this first immersion, than when the plates have been immersed for ten or fifteen minutes. If, therefore, a battery be so constructed as to give us this advantage, we may render it more portable, and cheaper in use, than those of the ordinary form, and such I have endeavoured to make the one now to be described.

It consists of two series of twelve cylinders of copper, enclosing twelve cylinders of zink, as represented in figs. 2 and 3 of the accompanying sketches. A A, fig. 2, outer copper cylinders; B B, inner copper cylinders; Z Z, zink cylinders. Each of the outer copper cylinders is 10 inches long and 2¼ inches in diameter, and each of the inner zink ones 6 inches long and 1½ inch in diameter. Each pair of cylinders is joined together by a copper bottom *d*, but the inner cylinder is open at both ends, while the upper end of the copper cylinder is closed water-tight by a copper cover *e*. The interior of the upper end of the copper cylinder is well varnished, for the purpose of preventing the action of the acid upon this portion of the cylinder. In each copper cylinder is a zink cylinder 6 inches long and about 1¾ inch internal diameter, which is fixed between the outer and inner cylinders, and retained in its position by corks, *x x x x*, so as to prevent any metallic contact between the zink and copper. A stout copper wire (*w*, fig. 2) well varnished is soldered to the zink, passes through a hole and cork in *d*, and is then soldered to the next copper cylinder in series, in the usual manner of connecting the several plates of a galvanic battery. The twelve double cylinders with their zinks are arranged in three rows, as shown in the plan, fig. 3, and kept firmly in this position by a wooden frame, in which they are supported by bars and cross bars, which also prevent the several copper cylinders from contact with each other. The frame is suspended by an axis between two uprights fixed into a broad firm base, just like a swing glass, but the axis is eccentric, and so placed, that the ends containing the zinks form a shorter radius than the empty portions of the copper cylinders. In this manner the whole is fairly balanced, and turns with ease and readiness. Fig. 1 is a view of the battery complete.

The exciting solution (one part sulphuric, one part nitric acid, and twenty parts water,) is poured into each cylinder through the pipe, B B, fig. 1, and care must be taken that no more is poured in than is just sufficient to cover the zink cylinders when they hang downwards. The battery, when not in action, hangs with the zink cylinders upwards; the exciting solution remains, of course, at the bottom of the copper cylinders (*c* end) and does not touch the zink; but if the battery be turned round, the zink cylinders being then downwards, the exciting solution runs upon them, and a powerful current of electricity is circulated. To throw the battery out of action, turn it once more half round; the exciting solution leaves the zinks, and all is again at rest. To enable an operator to throw the battery in and out of action while at a distance from it, a sheave or wheel (H, fig. 4,) is fixed upon the axis, and a cord is rove one turn round the sheave, and the end led to a convenient distance. The cartridges being placed in the rock and the conducting wires attached to the battery, the operator standing in a place of safety pulls the cord, the battery turning half round is thrown into action and an explosion takes place. Another pull at the cord, and the battery turns again into its original position, and is immediately thrown out of action, for the acid leaves the zinks, and consequently, an expenditure both of acid and zink is saved.

It will be seen that two important advantages are obtained by the use of this battery—*first*, great power by having the full benefit of the energetic current of first immersion; *secondly*, great cheapness, for it will be observed, that the ex-

penditure of acid and of plates takes place only during the time of explosion, and as this is but *momentary*, a most trifling loss is incurred; a shilling's worth of acid would work this battery for twelve months, even if it were employed for many explosions daily.

Yours very truly,
MARTYN ROBERTS.

June 5, 1843.

SUGGESTED IMPROVEMENT IN THE WORKING OF SHIPS' PUMPS.

Sir,—Having paid some attention to the causes of the great sacrifice of lives and property from shipwreck, I have been much struck by the fact, that nearly always these lamentable results might have been avoided, (but especially in the more recent cases of the *Conqueror* and the *Reliance*,) had means been at hand for keeping the vessels above water for only a few hours after the occurrence of disaster; which has been found impracticable from various causes, but all of them attributable to the inefficiency of the pumps at present in use, and the difficulty of continued exertion on the part of an exhausted crew. I profess no practical knowledge of these matters; but think I may safely consider this as the principal cause of the distressing calamities we are too frequently made acquainted with.

Accordingly, I solicit your attention to a remedy which I think may be found efficient, and I do so with little hesitation, as any proposition whose object is to avert the greatest calamity which can happen to our fellow beings, and the most overwhelming disasters which can affect an enterprising community, must always be worthy the consideration both of the man of science and the philanthropist.

I would suggest, that were ships' pumps made with what I may term the mouth considerably elongated, so as to act by hydrostatic pressure *on the principle of the syphon*, their action might be continued after *only a few strokes of the piston*, so long as there remained any necessity for their use; thus leaving the crew at liberty to perform the many other duties incident to disasters at sea, (but which are, of course, secondary to keeping the vessel afloat,) and without being fatigued and exhausted by their too often unavailing exertions at the pumps. I consider, that by this means a vessel might be kept afloat as long as her timbers held together, or, at least, valuable time would be gained, thereby increasing the chances of succour, or when near land affording the opportunity of running her aground. Another advantage would be this—the pumps could not be rendered useless (as is frequently the case) by becoming choked, as the piston-rod need not interfere with the passage of the element. A further advantage would be the ready and continuous supply of water they would afford in case of fire on board, which, as it mostly originates in the lower part of the vessel, would be instantly placed under control, by reversing the ends of the syphon, instead of depending upon the insufficient supply of water which any number of buckets could afford. Should this suggestion present promises of success, the details of its application could be readily supplied.

I remain, Sir, your obedient servant,
J. HALSE.

61½, Threadneedle-street,
June 6, 1843.

ON A PREVAILING ERROR IN ESTIMATING THE STRENGTH OF CYLINDRICAL BOILERS. BY THOMAS W. BAKEWELL.

(From the *Franklin Journal*.)

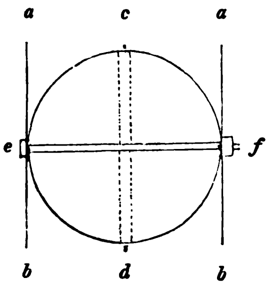
The Journal of the Franklin Institute for Nov. last* contains a report relative to the facts and probable causes of the explosion of a boiler in the steam-boat *Medora*, at Baltimore. This report affords another instance of respectable authority to a prevailing and dangerous error in estimating the capabilities of cylindrical boilers to sustain a given pressure of steam. It is there assumed that the force exerted to burst a cylindrical boiler, say at the top and bottom, as at *c* and *d* in the figure, is as the pressure on a space equal to the diameter, or as the base *a b*, and of equal dimensions, lengthwise of the boiler, to any portion of the boiler assigned for investigation—for instance, a ring of one inch in width, and forming part of the boiler.

The error seems to exist by considering each half of the boiler, which the steam tends to separate at *c* and *d*, as a strong and stiff body, capable in itself of sustaining its shape; and that the *horizontal* action, alone, of the steam, in the example now given, to sunder the parts at *c* and *d*, requires to be examined.

* See *Mech. Mag.* vol. xxxviii, p. 8.

In practice, all cylindrical boilers may be considered as composed of a flexible material, and especially when of the size of that in the *Medora*—132 inches in diameter; and their strength to consist in the tenacity of the boiler iron to resist a direct pull, the resistance to the steam by stiffness being scarcely appreciable.

Let the figure represent a ring, one inch in width, and forming part of a boiler; let it be cut at *c* and *d*, and the edges held together by the horizontal bolt, *e f*—thus



forming, by supposition, a steam-tight joint. Now, we can readily conceive how slight a pressure upwards and downwards would open the joint at *c* and *d*, notwithanding the horizontal bolt, *e f*, being in a position to sustain any pressure, thrown into a horizontal action, as contemplated by the received rule. But, if we first brace the boiler by the vertical bolts, where marked by the dotted lines on each side the joint, (waiving the action of the steam on the spaces between the letters) we should convert each half into a stiff and strong body, capable of retaining its shape; and then the received rule would be correctly applicable, viz., that the force to separate the boiler at *c* and *d*, would be as the pressure on a space, equal to the diameter, or as the base *a b;* and the horizontal bolt sustaining that pressure, would prevent the boiler parting at *c* and *d*.

Let us now suppose the boiler entire, (not cut,) and the vertical bolts removed; then, if steam be admitted, the boiler must sustain, by horizontal tension, at *c* and *d*, in the disadvantageous manner of a string, stretched horizontally, bearing weight, what was previously sustained by the vertical bolt; and this mode of action by the steam is neglected by the received rule.

In the above exemplifications, I have granted an item beyond what exists in reality. It is, the continuance of the horizontal bolt in position to prevent, effectually, according to the received opinion, the separation at *c* and *d*—although, in treating the ring, or boiler, as it is, in fact, of a flexible material, no efficient support could be derived from the horizontal bolt by the parts *c* and *d*. And if we again introduce the vertical bolts as by the dotted lines, the parts *c* and *d* would be completely protected, and the pressure might be urged to bursting, when the boiler, or ring, would part in the middle of one of the spaces, between the letters.

On the received rule, the horizontal bolt is the ostensible support of the parts *c* and *d*, and the vertical bolts negative in their effects; but if we remove the horizontal bolt, and let the vertical bolts remain, the parting point would be yet more determinately removed from the said parts, *c* and *d*, and would be at *e*, or *f*.

I have thus endeavoured to show a deficiency unprovided for in the received rule, which, when included in the estimate, makes the effective force to tear asunder the boiler at *c* and *d*, equal to the sum of the pressures on the semi-circumference; which force is sustained, one-half each, by the parts at *c* and *d*, being as the pressure on the quarter circle to part the boiler at any one point—whereas the received rule gives the force as the pressure on half the diameter, and the difference is as 1·57 to 1.

In the Journal of the Franklin Institute, vol. iv. for Aug. 1829, may be found a communication from me on this subject, wherein a mode of arriving at the value of my estimate is shown; and although there are other methods of demonstration, perhaps the one there offered may be as obvious as any. I apprehend, however, no confliction on this head, for the result flows from acknowledged laws.

The main object of the present article is to call attention to the very serious error in the premises on which the prevailing opinion is predicated, and to the important fact that there is 57 per cent. more force exerted by steam of a given density to cause an explosion, than is usually assigned.

With respect to the boiler of the *Medora*, the same discrepancy exists between the estimated pressure, by the received rule, of what it would bear, and the amount established by the witnesses—as in most cases of explosions—when far-fetched and improbable causes are enlisted to fill the gap between the engine builder and engine tender.

The conviction of the correctness of my views in this matter is not lessened by their being conceded by men, to whom they have been presented, whose attainments embrace the subject, and whose opinions are entitled to every consideration.

Cincinnati, Dec. 6, 1842.

DESCRIPTION OF THE CONCRETE BRIDGE OF GRISOLES, ERECTED BY M. LEBRUN, OF MONTABAN, ARCHITECT.

[Translated from the *Bulletin de la Societé d'Encouragement pour l'Industrie National.*]*

Living in a region where suitable building stone is scarce and expensive, and where brick masonry alone is used, M. Lebrun, guided by the fine works of M. Vicat, on hydraulic limes, conceived the idea of substituting for this masonry the *béton*, which the Romans used with so much advantage.

In consequence, he submitted, in 1839, to the Minister of Public Works, the design of a bridge entirely of concrete (*béton*,)† which he offered to construct on the branch canal of Garonne. This offer having been accepted, under certain conditions, M. Lebrun commenced his work in June 1840.

I.—*Selection and Preparation of the Materials.*

The *lime* was of the hydraulic quality, burnt by pit-coal. The *sand* was clear of all earthy particles, of fine grain, and pretty uniform. The *gravel stones*, of the size of a hen's egg, came from the river Garonne. The lime was slaked alternately in two basins, joined together. For this purpose, we poured at first, in one of the basins, a quantity of water proportioned to that of the lime which we wished to slake; we then put in sufficient quicklime for the water to cover it; then we left the lime to slake freely without disturbance, except by taking care to prick it, from time to time, with a stick, to introduce the water into those parts of the basin where the dissolved lime was dry. When the fermentation had ceased, we stirred up the lime in every direction with an iron hoe, in order to mix the paste, and render it homogeneous; we left it then in this state, not to be used for twelve hours after slaking.

The proportions observed by M. Lebrun for concretes destined for the construction either of walls or arches, were, in every ten parts, composed of two parts of lime in paste, three parts of sand, and five parts of gravel stones, or pebbles.

For making the mortars, we placed, on a paved surface, two measures of the slaked lime, which, after having been well beaten with pestles of cast iron, softened again by yielding up a part of the water with which it was charged; then we placed beside it three measures of sand, which we mixed, little by little, with the lime, always having the aid of the pestles, and stirring the whole with the shovel and hoe, in order that all the parts of the sand should be well incorporated, observing not to put any water into the mortars, but, if the sand was too dry, we moistened it a few moments before mixing. As soon as the mortars were sufficiently manipulated, we added five measures of gravel stones; the whole was then long and forcibly mixed and pounded, until each part of the gravel was sufficiently enveloped by mortar. We took care to make only what we could employ in a day's work, without which precaution it would have lost its cohesion.

II.—*Construction of the Abutments.*

The 15th of June, 1840, the foundations of the two abutments being excavated, we commenced laying the concrete, taking care, each time that a layer or course was finished, to cover it up imme-

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* We have adopted, with some corrections, the translation of this paper, made by Mr. Ellwood Morris, C. E., for the Franklin Journal. — Ed. M. M.

† The French *béton* is nearly identical with the English *concrete*, the main difference being the manipulation; thus *béton* is composed of lime, sand, and small pebbles, or broken stone, *taken separately*, and successively mixed together, the pebbles being added last; while *concrete* is usually formed of lime, mixed directly with gravel, *containing naturally* about the due proportion of *pebbles and sand;* proper quantities of water being used, and the factitious stone resulting, in both cases, being in effect the same.

Béton, or concrete, has before been used in retaining walls and other constructions, and, as it is stated by Gen. Pasley, of H. B. M. corps of Engineers, (in his Treatise on Calcareous Cements,) it was also applied experimentally to build a military casemate near Woolwich, of which the arch had 18 feet span, 5 feet rise, and 6 feet depth at the crown, and which, when subjected to the direct fire of 24 pounder guns, as well as the vertical plunge of 13 inch shells, loaded to weigh 200 lbs. each, resisted both with success, and, contrary to expectation, was less injured by the latter, than by the former.

General Treussart, of the French army, after mentioning the successful construction of several concrete vaults, recommended this material for aqueduct bridges, and for the revetements of fortresses, in certain situations.

Nevertheless, the bridge here described is amongst the first, *if not the very first*, of this description.

We must, however, observe, that the failure of the concrete wharf walls, at Woolwich and Chatham, in consequence of tidal exposure, and the necessary protection of the concrete sea wall at Brighton, with woodwork, to shield it from the action of water in mass, (as mentioned by Gen. Pasley.) points out the necessity of confining the application of *concrete* to constructions within reasonable and proper limits.—Tr.

diately with wet mats of straw, to prevent a too rapid drying by the heat of the sun. By means of this precaution, the new course connected itself more intimately with the one below. We continued the masonry all of concrete, (the backing of the arch and abutments keeping pace,) until reaching the height fixed. The exterior faces of the abutments, (not next the earth,) and of the walls, were formed by some planks, strongly fixed, against which the concrete rested. These planks were removed, two or three days after, and the faces of concrete remained exposed, and were very well preserved. At the height of the springing of the arch, we laid five courses of bricks plumb on the faces of the abutments, to serve as perpendicular faces for the centre to fit up against, and enable it to detach itself easily.

Fig. 1.

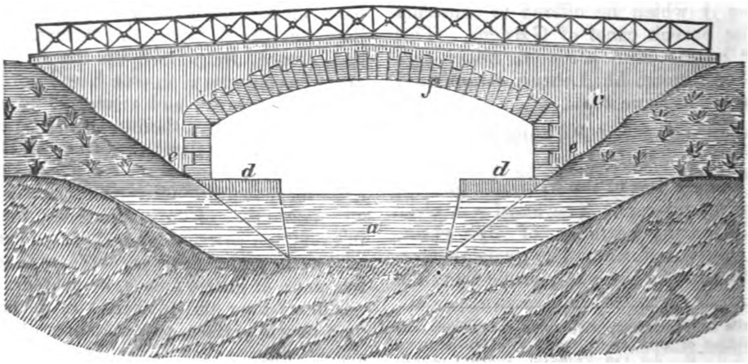
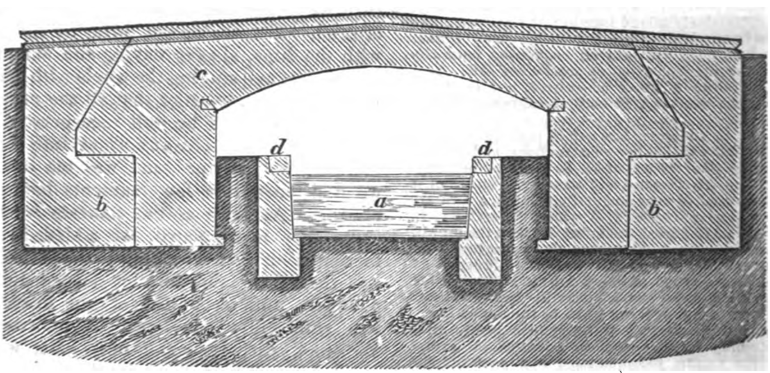


Fig. 2.



III.—*Construction of the Centre.*

Fifteen days after laying the last course of concrete, we commenced the construction of the centre, composed of many courses of bricks, laid flat, in succession, (from the spring towards the crown,) following the curve of the arch at the intrados, built partly with plaster, and partly with cement, or hydraulic mortar, and supported at the springing by projecting masonry, or by a plank for that purpose. The centre was formed of four courses of bricks, (in thickness, or depth, say 9 inches;) the three lower were laid with plaster, and the upper course with cement, to shelter the plaster from the dampness of the concrete. The upper bricks of the centre were covered by a

bed of mortar of clay, in order to model perfectly the intrados of the arch, and to hinder the concrete from forming one body with the bricks.

The construction of the centre being finished on the 17th of August, we established, three days after, the masonry of the two heads of the arch of brick, which were completed on the 26th of the same month.

IV.—*Construction of the Arch.*

Immediately after the construction of the two heads, we wrought them into the general mass of concrete, forming the arch; this operation was finished on the 5th of September, with the exception of the backing up, which was accomplished, on both sides, the 11th of the same month. The courses of concrete of the arch were composed in the same manner as those of the abutments, and manipulated by the same process; but we added to it $2\frac{1}{10}$ cubic feet of *cement* for every $35\frac{1}{4}$ cubic feet, or $\frac{1}{17}$th, of the mass, to augment the strength of the mortars of the body of the arch. This construction was made without following any regular order, and the concrete was cast in masses, upon the centre, to the thickness of 2 feet, which formed the first general bed, or layer, on the development of the arch. The first bed being finished, we formed the second in order to reach the thickness of 3 feet at the key, the spandrel backing, and the abutments being levelled up. A coping of hydraulic mortar was then placed over the whole extent of the arch, and covered immediately with a layer of clay, strongly beaten.

V.—*Striking the Centre.*

All was left in this state until the 25th of January, 1841; we then proceeded to the operation of striking the centre of the arch. The 28th of January, the centre of bricks was taken away, and the intrados of the arch appeared very even in all its parts. After three months, it manifested not the smallest settlement in its masonry, and, since then, the bridge has stood through the summer, without incurring the least sinking capable of affecting its solidity. This bridge has a clear opening of $39\frac{1}{4}$ feet between the abutments; the middle is placed in the axis of the canal, which has two towing paths; its breadth is $19\frac{3}{4}$ feet between the heads, or faces, of the rings; and the arch is formed of a segment of a circle of $39\frac{1}{4}$ feet chord, and $5\frac{1}{4}$ feet rise, or versed sine.

The entire mass of the abutments is of concrete, except the four angles on the sides of the towing paths, which are of large stone, rounded on the arris, on account of the rubbing of the towing lines. The arch is also of concrete, as are the faces of the tympans, or spandrels, and the intrados, with the exception of the arrises of the soffit, or rings of the heads, which are of brick masonry.

M. Lebrun has annexed to his memoir, along with a plan of the bridge of Grisoles, many certificates, from the mayor of this commune, and from the engineer of the lateral canal of the Garonne, proving the complete success of the works, and the solidity of the construction, which has endured the proof of the passage of loaded carriages, the numerous influences of heat, and some very severe frosts, without having indicated the least subsidence or disturbance.

VI.—*Explanation of the Figures.*

Fig. 1 is an external elevation of the bridge.

Fig. 2 a sectional elevation.

a, canal; *b*, abutment of concrete; *c*, mass of arch, also of concrete; *d d*, towing paths; *e*, angles of bridge upon the tow-paths, built of large stone, with the angles rounded; *f*, arrises of the soffit, or bands of brick at each head of the arch, instead of the usual ring-stone.

INSTITUTION OF CIVIL ENGINEERS.

MINUTES OF PROCEEDINGS—SESSION 1843.

February 28.

"*Description of the roofs over Buckingham Palace, covered with Lord Stanhope's composition.*" *By Peter Hogg, Assoc. Inst. C. E.*

The mixture invented by Lord Stanhope, and used by the late Mr. Nash, for covering the nearly flat fire-proof roofs of Buckingham Palace, is described in the paper as being composed of Stockholm tar, dried chalk in powder, and sifted sand, in the proportions of three gallons of tar, to two bushels of chalk, and one bushel of sand, the whole being well boiled and mixed together in an iron pot. It is laid on in a fluid state, in two separate coats, each about $\frac{3}{8}$ths of an

inch in thickness, squared slates being imbedded in the upper coat, allowing the mixture to flush up between the joints the whole thickness of the two coats, and the slates being about an inch.

The object in embedding the slates in the composition, is to prevent its becoming softened by the heat of the sun, and sliding down to the lower part of the roof, an inclination being given of only $1\frac{1}{2}$ inch in 10 feet, which is sufficient to carry off the water, when the work is carefully executed. One gutter, or water-course, is made as near to the centre as possible, in order to prevent any tendency to shrink from the walls, and also that the repairs, when required, may be more readily effected. It is stated, that after a fall of snow it is not necessary to throw it from the roof, but merely to open a channel along the water-course, and that no overflowing has ever occurred; whereas, with metal roofs it is necessary to throw off the whole of the snow on the first indication of a thaw.

These roofs have been found to prevent the spreading of fires, and it is stated, that on one occasion, to test their uninflammability, Mr. Nash had a bonfire of tar barrels lighted on the roof of Cowes castle.

Another advantage is stated to be, the facility of repair which the composition offers, as if a leak occurs, it can be seared and rendered perfectly water-tight, by passing a hot iron over it; and when taken up, the mixture can be remelted and used again.

The author proposes to obviate the disadvantage of the present weight of these roofs, by building single brick walls at given distances, to carry slates, upon which the composition should be laid; instead of filling the spandrels of the arches with solid materials, as has been hitherto the custom.

The reported failures of this species of covering at Mr. Nash's house in Regent-street, and in other places, are accounted for by the composition having been used in one thin coat, laid upon an improper foundation of laths and tiles.

The durability of the roofs, which were carefully constructed with good materials, has been, it is contended, fully proved at Lord Palmerston's house, which was covered with the composition in 1807, Lord Berwick's, in 1810; Sir James Langham's, in 1812; the Pavilion at Brighton, in 1816 and 1823; and nearly the whole of Buckingham Palace, in 1826 and 1829; the latter roofs are stated to be in perfect order at the present time, and have scarcely demanded any repairs since their completion.

The papers illustrated by a drawing, showing the mode of constructing the roofs, and the improved method proposed by the author, with specimens of the composition, with slates imbedded, taken from the roof of the palace during some recent alterations.

Mr. Poynter presented a drawing of the mode of setting the pots for melting and preparing the composition, the proportions of which he stated somewhat differently from those given in the paper.

Three measures of ground chalk, dried and sifted very fine, were mixed and kneaded up with one measure of tar; these ingredients were melted in an iron pot, set in such a manner that the flame should not impinge too violently upon it. The first, or "skimming" coat of the covering being laid on of a thickness of $\frac{3}{16}$ths of an inch, the finishing coat was composed by adding to the former mixture three measures of hot sifted sand, well mixing the whole together; the composition was laid on with a tool similar to a plasterer's trowel, but much stronger.

Mr. Nash, when he first tried the composition, found that the surface became disintegrated by exposure to the weather; he therefore added the slates imbedded in the second coat, and subsequently never used the mixture without them.

In reply to questions from the President and other members, Mr. Nixon stated, that he was employed under Mr. Nash when the palace roofs were executed, and he could bear testimony to their durability and soundness. The roofs at East Cowes castle, which were covered with the composition in the year 1808, and those of the Pavilion at Brighton, in 1816, were now in as good a state as when they were finished. The failure at Mr. Nash's house in Regent-street arose from the roof having been originally composed of mastic, which soon cracked. One coat of the Stanhope composition was spread over it, to stop the leaks, but it was insufficiently done, and ultimately Mr. Rainy had a new roof, properly constructed, with two coats of composition, which had remained sound to the present time. The price of these roofs, when well constructed by the person who did those of the palace,* was about five guineas per square.

Mr. Hogg observed, that the chalk was only exposed to such a heat as would evaporate any moisture it contained. The weight of the two coats of Stanhope composition, including the slate imbedded in it, was about 12 lbs. per superficial foot.

Mr. Sibley considered the Seyssel Asphalte, when carefully laid, preferable to any composition of a similar nature; he had used it

* Mr. Millson, No. 6, Frances-street, Tothill Fields, Westminster.

extensively, and was well satisfied with it, both for roofing and paving.

Mr. Hogg objected to the use of asphalte for roofing, as it was liable to injury, being of a brittle nature; it was not elastic, and it shrunk from the walls, thereby causing leaks. Lord Stanhope's composition did not possess these faults, and he did not consider that it was superseded by asphalte.

Mr. Moreland had covered the roof of the treadmill at the Giltspur-street Compter with asphalte, and had found it answer perfectly. It was laid on in a thickness of $\frac{3}{8}$ths of an inch, upon roofing boards $\frac{3}{4}$ths of an inch thick, with canvas nailed on them; with an entire fall of only 9 inches, there was not any appearance of leakage.

Mr. Davison had caused a school-room to be floored with asphalte, four years ago, and up to the present time there was no symptom of wearing down, although the stones, which were let into the floor, for supporting the desks, &c., were considerably abraded. He believed that the only failures of the asphalte had occurred from the use of inferior ingredients. Gas tar had been used instead of vegetable tar, and in those cases the result had not been successful.

"*Account of the Victoria Bridge, erected across the River Wear, on the line of the Durham Junction Railway.*" *By David Bremner, Assoc. Inst. C. E.*

The district through which the Durham Junction Railway passes, for the purpose of completing the connexion between the city of Durham, with the towns of Newcastle, South Shields, and Sunderland, is extensively undermined by coal-workings, and great caution was requisite in the selection of a spot which suited the level of the railway, and where a foundation could be formed sufficiently sound to support such a structure as the bridge described in the paper. The advice of Messrs. Walker and Burges was therefore sought by Mr. Harrison, the engineer of the line, and their design was adopted; but subsequently several alterations were made, either to favour the locality or from motives of economy.

The bridge is 810 feet 9 inches long, and 21 feet wide, between the parapets. It is, with the exception of the quoins of the main arches, built of freestone, from the Pensher quarries; there are three semi-circular arches, of 144 ft., 100 ft. and 60 ft. span respectively, a centre arch of 160 span, with a radius of 72 feet, and three arches of 20 feet span each at either end, forming the abutments. The main pier is founded upon rock, 24 feet beneath the bed of the river; and the height from the foundation to the top of the parapet is 156 feet 6 inches; the under side of the main arch, at the crown, is thus 121 feet 9 inches above the level of the sea.

The paper describes at length the nature of the building materials employed, the dressing of the stones, the composition of the mortar, the general detail and dimensions of the construction, the centring of the arches, with the precautions used in striking them, and gives a very full account of the travelling and other cranes employed in the construction; these are stated to have been very efficient. The north arch, of 100 feet span, containing about 980 tons of stone, was entirely turned with two of the cranes, in 28 hours, giving an average weight of $17\frac{1}{2}$ tons of stone laid by each crane per hour.

The perseverance and practical skill of Messrs. Gibb, of Aberdeen, the contractors, are particularly mentioned, as the difficulties attending the getting down the foundations, especially that of the main pier, were very great, and required all their talent and energy. The detail is given of the precautions taken with the coffer-dam, in which at one period a steam-engine of twenty-horses power, working two pumps of 18 inches diameter each, was insufficient to keep down the water, and it became necessary to drive a range of sheet piling all round withinside the dam, before the leakage through the bad strata above the rock could be stopped.

By calculation it appears, that the pressure on the foundation of the highest pier in the bridge is about 37 tons on each square foot, exclusive of the additional weight of the passing coal-trains, which frequently weigh 120 tons each.

The bridge was commenced on the 17th of March, 1836, and was finished on the 28th of June, 1838, occupying about 714 working days, and cost, with the extra works, nearly £40,000.

The paper is illustrated by three drawings, showing a plan and elevation of the bridge in several stages of its construction, and when completed; the details of the centres, hoists, and cranes, the coffer-dam, engine, pumps, and of the foundations of the whole structure.

Mr. Vignoles had examined the bridge very minutely, and had been much struck with the excellence of the workmanship, which was quite in accordance with the beauty and simplicity of the original design; it was an extraordinary example of care and attention on the part of the contractors, and did infinite credit to all engaged in it; yet with all this, it had cost less, in proportion

to its dimensions, than any similar structure in this country.

The President observed, that the structure first proposed was to have been of cast iron, but when he and his partner, Mr. Burges, were consulted, they advised the employment of the freestone from the adjoining quarries, on Lord Londonderry's estate, and they furnished a design, based upon that of Trajan's bridge, at Alcantara, which was adopted by the directors; but subsequently an alteration was made, by introducing three small arches in each abutment, which, in his opinion, had injured the design; that was the extent of his connexion with the bridge; the merit of the construction must be given to the engineer and the contractors, and he must corroborate the statement of the superior manner in which the work had been executed. The bridge had been placed nearly at the spot marked out by Mr. Telford, for the Great North Road to cross the Wear, and as the railway would now form part of the line between Newcastle and Darlington, Mr. Telford's plan would be virtually executed, although with the difference of substituting a railway for a turnpike-road.

"Description of the American engine 'Philadelphia,' made by Mr. Norris, of Philadelphia, North America, for the Birmingham and Gloucester Railway." By G. D. Bishopp; communicated by Captain W. S. Moorsom, Assoc. Inst. C. E.

The engine described in the paper was made in the year 1840, and has been in regular work for upwards of two years as an assistant engine upon the Lickey inclined plane, which rises at an angle of 1 in 37½, and is 2 miles 4 chains long.

Its construction is what is termed a "Bogie" engine, having a four-wheeled truck to support one end of the boiler, while the other end rests upon the driving wheels. It has outside cylinders, inclined so as to clear the bogie wheels, over which they are placed, and it has inside framing.

The boiler is cylindrical, 9 feet long, and 3 feet 4 inches diameter, of plates ⅜-inch thick. The fire-box attached to it has three of its sides square, and the front semicircular, with a spherical dome on the top, and the area of the fire-grate about 10 square feet; it was originally constructed of iron, with water spaces 2½ inches wide, the crown being supported by stay bars, in the usual manner, but it was destroyed in about eight months, and has been replaced by a copper fire-box of plates ⅜-inch thick, with a tube plate ⅞-inch in thickness. The tubes are 94 in number, 8 feet 11 inches long, and 2 inches diameter outside: they were originally of copper, but were replaced by brass tubes when the new fire-box was fixed. Midway between the two end plates, is a third plate, through which the tubes pass, so as to serve as a support, and to prevent them from sinking in the middle. The total internal area of the tubes is 404 square feet.

The chimney is 13¾ inches diameter internally, by 13 feet 10 inches high from the rails, and has not any damper.

The framing is entirely of wrought iron, with the axle guides, &c., forged upon it. The "bogie" frame is also of wrought iron; it is attached to the smoke-box by a centre pin, and is carried by two pair of wheels, 2 feet 6 inches in diameter, made of cast iron, chilled, and without tires.

The driving wheels are 4 feet diameter, also of cast iron, but with wrought iron tires; they are firmly fixed upon a straight axle, as the cylinders are outside.

The cylinders are 12½ inches diameter inside, with a length of stroke of 20 inches.

Minute dimensions are given of the steam passage and valves (the "lead" of which is ⅛-inch, and to the eduction pipe nearly ¼-inch, the motion of the slide extending $1\frac{1}{32}$ inch on either side of the centre line;) the steam-chests, the regulator, the gearing and feed-pumps, and all the other parts of the engine and connexions.

The general summary of the work done (the details of which are in the archives of the Institution of Civil Engineers*) shows that with a maximum load of 8 waggons and 20 men, making a weight of 53¾ tons behind the tender, the engine ascended the Lickey inclined plane at a speed of between 8 and 9 miles per hour; that with 6 waggons, or 39½ tons, the speed was between 10 and 11 miles per hour; that with 5 waggons, or 33 tons, the speed increased to between 12 and 15 miles per hour; and that in assisting the ordinary trains, was 7 passenger carriages, the usual speed has been 13½ miles per hour.

There are three engines of this class kept at the Lickey inclined plane for assisting the trains in their ascent, but one is generally found sufficient for the daily service.

The communication is illustrated by seven drawings of the engine, and its details of construction, which have been communicated through Captain W. S. Moorsom, Assoc. Inst. C. E.

Captain Moorsom, in answer to questions from members, explained that—

* "Account of a Series of Experiments on Locomotive Engines," &c., by Captain Moorsom, with Supplement, read April 7, 1840.

	Miles.	Chains.
The length of the Lickey incline, rising 1 in 37$\frac{4}{10}$ths, was	2	4
The bank engine ran from out its house at the foot of the incline, at each trip, for a length of	0	14
And continued running at the head of the train after surmounting the incline, for about	0	23
Thus giving an actual length on the ascent of	2	41

And as the same distance was covered in returning, the length of each trip was rather more than 5 miles. This was exclusive of some occasional piloting and train trips, which were, however, included in the general statement of expenses.

The account of the entire expense of the bank engine establishment was made up of —1°, the wages of the drivers and firemen; 2°, Cost of coke, oil, and tallow; 3°, Repairs, including wages, and materials; 4° Depreciation of stock, stated at the end of each half-year; 5°, General charges, comprising wages of pumpers, cokemen, cleaners, and labourers; cost of firewood, hose-pipes, cotton waste, and all other stores; salaries of superintendents, clerks, foremen, timekeepers, and store-keepers; and the premium paid to the men for saving the coke.

The cost of working the inclined plane was therefore, for each half-year ending—

	31st December, 1841.	30th June, 1842.	31st December, 1842.
	£ s. d.	£ s. d.	£ s. d.
Wages	132 7 11	95 9 10	117 14 8
Coke	324 13 6*	191 11 4†	165 19 0‡
Oil and Tallow....	49 8 4	27 1 7	17 18 6
Repairs	245 1 0	260 3 8	92 6 11
General Charges ..	237 19 7	93 15 7	76 6 11
	989 10 4	668 2 0	470 6 0
Depreciation of Stock	99 0 0	Nil, having been improved.	89 16 0
Total..	1,088 10 4	668 2 0	560 2 0
Trips run........	1,242	1,276	1,320
Miles run........	6,210	6,380	6,600
Cost per mile run—	s. d.	s. d.	s. d.
1st, Exclusive of Depreciation	3 2¼	2 1	1 5
2nd, Including Depreciation	3 6	0 0	1 8½

* 27*s.* per ton. † 26*s.* 4*d.* per ton. ‡ 25*s.* 11½*d.* per ton.

The engines had been improved by the alterations made since their arrival in England. These changes chiefly consisted in suppressing the tender, and placing the receptacle for water and coke upon the boiler of the engine, and in using the waste steam to heat the water; these had increased the efficiency of the machine, and caused a considerable economy of fuel. All the other changes were of minor importance, and had been chiefly suggested by the exigencies of the peculiar locality where the engine worked. The economical working of the engine was due partly to the attention and skill of the driver, who had become better acquainted with the capabilities of the machine, had a better knowledge of the locality, and was stimulated by a premium upon the saving of coke and other stores consumed, but was principally to be attributed to the judicious alterations that had been made in the construction. There had not been any reduction of the men's wages.

The usual pressure of steam was between 60lbs. and 66lbs. per square inch.

The weights of the trains varied considerably; they rarely consisted of less than three carriages; the heaviest, he remem-

bered, weighed 98 tons, exclusive of the weight of the two engines, which were employed to convey it up the incline.

He had not made any accurate experiments as to the amount of slipping of the wheels upon the rails, but with the ordinary traffic he did not believe that any practical loss was occasioned by it.

Mr. M'Connell stated that the pressure of steam in the boiler of the American engine, when the experiments were tried, was more than 70lbs. per square inch; the spring balance was screwed down to 65lbs. pressure, and as owing to the reduced speed of the engine, the steam was generated faster than it could be consumed by the cylinders, and thrown off by the safety valves, the pressure continued increasing. It should be understood that Bury's engine, alluded to in the experiments, was intended rather for conveying trains at higher velocities, than for mounting the incline with a heavy load; it was therefore labouring under a disadvantage. The steam ports in the American engine were very large, and although steam was thereby wasted, that arrangement was of material assistance in the peculiar duty for which the machine was intended.

Mr. Braithwaite observed, that the quantity of coke consumed appeared to exceed materially that upon other railways; he understood that an engine recently constructed by Messrs. Rennie used about 18lbs. per mile, and that on the Liverpool and Manchester line the average consumption was 16lbs. per mile. It appeared to him that the real questions were—the absolute duty performed with a given quantity of fuel, and at what cost? and also whether the greater adhesion of the driving wheels was due to the weight imposed upon the engine, by fixing the water tank upon the boiler, and the coke boxes upon the foot-plate, after suppressing the tender.

Mr. M'Connell replied that the peculiar duty of these bank engines required the steam to be kept up for about 16 hours daily, during which period they made eight trips, amounting in the whole to about 40 miles, of which, during 20 miles only actual duty was performed, so that the greater portion of the coke was consumed while the engines were at rest. When they were running with luggage trains on the line the quantity of coke consumed was very small. The difference of cost, in consequence of the various alterations, and the improved mode of working the engine, was very great. In January, 1842, the cost per trip on the incline was 17*s.* 5*d.*; but in Jan., 1843, it only amounted to 7*s.* 1½*d.*

The average weight of the luggage trains was about 60 tons; two assistant engines were used for heavy trains, merely as a precaution, in case of the wheels slipping; otherwise one of the "Bogie" engines could perform the duty alone, as with the passenger trains, which were always conveyed up by the bank engine alone.

Captain Moorsom said that the main question arising from this investigation, was by what system steep gradients could be worked, with the greatest efficiency, security, and economy; he would, however, in the present case suppose the two former positions to be equal in both cases, and would inquire only into the economy.

It appeared from the returns of the London and Birmingham Railway Company, that the annual cost of working the Euston-square incline plane, which was 1⅛ mile long, with an average angle of 1 in 98, with stationary power and an endless rope, was—

In 1840	£2,150
1841	1,376
1842	1,215

On the Edinburgh and Glasgow Railway, the expenditure upon the Glasgow incline, which was about one mile in length, at an inclination of 1 in 42, also with stationary power, was 1,516*l.* in 1842.

He had understood (but he could not produce authority for his statement) that, on the Great Western Railway, the cost of working the Box Tunnel incline alone, was, in 1841, about 3,500*l.*; and in 1842 it had been reduced to nearly 2,500*l.*; that was worked by locomotive power.

Taking into consideration the number and weight of the trains, their speed, and the relative length and the angle of the inclines, he believed that the Euston-square incline might be said to perform about half as much work as that on the Lickey.

Mr. M'Connell presented drawings of the locomotive after being altered, of the detaching catch, and of the improved brake.

After detailing some important alterations made by him in the valves as well as the substitution of a different description of fire-bars and fire-frame, under an arrangement by which a considerable saving had been effected in the consumption of fuel, he stated that, for several reasons, but chiefly to increase the adhesion of the driving wheels of the engine, the tender had been suppressed, and a large tank constructed to be carried on the boiler of the engine. It was made of the best plate iron, ¼-inch thick; its length was 8 feet 9 inches, breadth 3 feet 5 inches, depth 3 feet at the sides, and 1 foot 11 inches at the centre: the bottom was made to fit the form of the boiler, and was bedded upon a coating of thick felt; it was held in its place by four wrought-iron straps passing round the boiler.

Advantage had been taken of the waste steam, by introducing a copper pipe from the top of the fire-box dome, into the upper part of the tank, carrying it, to and fro, from one end to the other, with an open extremity to allow the escape of the steam into the water; this pipe was furnished with a stop-cock; in addition to this, a number of pipes were introduced from the smoke-box into the tank, by which arrangement, the water in the tank was maintained at the boiling temperature, previous to being pumped into the boiler, which, in addition to the saving of fuel, proved advantageous in diminishing the leakage and breakage of the tubes and stays, arising from the sudden contraction by pumping in cold water, when the steam was shut off while descending the incline.

The tank contained upwards of 400 gallons of water, a quantity sufficient for the engine over 18 miles, and goods' trains had been taken the whole length of the line (53 miles) by these engines with safety and economy.

The supply of coke was carried in sheet-iron boxes, each containing about 40 lbs. weight, and of a size to fit the fire-door of the boiler, ranged on platforms on each side of the foot-plate, which platforms were fitted with boxes, to hold the necessary tools required for the engines.

Mr. M'Connell then described a powerful and efficient description of brake, which he had constructed to act upon the driving wheels; it was so arranged that the whole weight of the fire-box end of the engine could be thrown on the wheel tires; one brake had been found quite sufficient to stop the engine on any part of the incline; from their position they were very easily brought into action; the end working upon the fore part of the wheel, was connected to a stud made fast to the framing of the engine; the other end was worked by a screw $1\frac{5}{8}$ of an inch in diameter, passing through a bracket fixed on the boiler, which served as a nut. The main spring-plate of the brake was rendered flexible by the wood blocks being in short segments, thus enabling their entire surface to be brought into close contact with the periphery of the wheel.

A new form of catch, employed for detaching the engine from the train, was described; it was stated to be managed with facility, and at the same time was perfectly secure.

The principal advantages of these engines were, he believed, the economy in the consumption of fuel, and the increased adhesion of the driving wheels (the weight upon them being upwards of 10 tons, thus rendering the engine more effective in drawing heavy loads). The expenses of repairs had also been much decreased by the improvements suggested by practice.

The following statement showed the comparative consumption of coke at different periods, viz.—

For six months ending	June,	1841,	92·41 lbs. of coke per mile run.
,,	January,	1842,	86 ,,
,,	June,	1842,	53·35 ,,
,,	January,	1843,	43·2 ,,

March 7, 1843.

"*On the causes of the unexpected breakage of the Journals of Railway Axles; and on the means of preventing such accidents by observing the Law of Continuity in their construction.*" *By William John Macquorn Rankine, Assoc. Inst. C.E.*

The paper commences by stating that the unexpected fracture of originally good axles, after running for several years, without any appearance of unsoundness, must be caused by a gradual deterioration in the course of working; that with respect to the nature and cause of this deterioration, nothing but hypotheses have hitherto been given; the most accepted reason being, that the fibrous texture of malleable iron assumes gradually a crystallized structure, which being weaker in a longitudinal direction, gives way under a shock that the same iron when in its fibrous state would have sustained without injury.

The author contends that it is difficult to prove that an axle which, when broken, shall be found of a crystallized texture, may not have been so originally at the point of fracture, although at other parts the texture may have been fibrous.

He then proceeds to show that a gradual deterioration takes place in axles without their losing the fibrous texture, and that it does not arise from the cause to which it is usually attributed.

From among a large collection of faggoted axles which had broken after running between two and four years, five specimens were selected, of which drawings are given, representing the exact appearance of the metal at the point of fracture, which in each case occurred at the re-entering angle, where the journal joined the body. The fractures appear to have commenced with a smooth, regularly-formed, minute fissure, extending all round the neck of the journal, and penetrating on an average to a depth of half an inch. They would appear to have gradually penetrated from the surface towards the centre, in such a manner that the broken end of

the journal was convex, and necessarily the body of the axle was concave, until the thickness of sound iron in the centre became insufficient to support the shocks to which it was exposed.

In all the specimens the iron remained fibrous; proving that no material change had taken place in its structure.

The author then proceeds to argue, that the breaking of these axles was owing to a tendency of the abrupt change in thickness where the journal met the shoulder to increase the effect of shocks at that point; that owing to the method of manufacture the fibres did not follow the surface of the shoulder, but that they penetrated straight into the body of the axle; that the power of a fibre to resist a shock being in the compound ratio of its strength and extensibility, that portion of it which is within the mass of the body of the axle will have less elasticity than that in the journal, and it is probable that the fibres give way at the shoulder on account of their elastic play being suddenly arrested at that point. This he contends would account for the direction of the fissure being inward towards the body of the axle, so that the surface of the fracture was always convex in that direction.

It is therefore proposed, in manufacturing axles, to form the journals with a large curve in the shoulder, before going to the lathe, so that the fibre shall be continuous throughout; the increased action at the shoulder would thus be made efficient in adding strength to the fibres without impeding their elasticity. Several axles having one end manufactured in this manner, and the other by the ordinary method, were broken: the former resisted from five to eight blows of a hammer, while the latter were invariably broken by one blow.

The vibratory action to which axles are subjected is then considered, and it is contended, that at the place where there is an abrupt change in the extent of the oscillations of the molecules of the iron, these molecules must necessarily be more easily torn asunder; and that in the improved form of journals, as the power of resisting shocks is increased by the continuity of the superficial fibres, so is the destructive action of the vibratory movement prevented by the continuity of form.

The paper is illustrated by five drawings, showing the section of the journals of broken axles, and their appearance at the moment of fracture.

Mr. York agreed with Mr. Rankine in several points, and stated, that since the last meeting he had made a series of experiments, which confirmed his opinion ralative to the vibration in solid railway axles being arrested, when the wheels were keyed on tight. In all such cases, where the vibration was checked, fracture would, he contended, be more likely to ensue, but with hollow axles there was very little difference of sound when struck, and no diminution of strength after keying on the wheels; this he attributed to the regular distribution of the molecules in the metal of the hollow cylinder.

Mr. Parkes coincided with Mr. York's opinion, and he believed that hollow axles would eventually supersede solid ones, particularly if they had sufficient rigidity for resisting flexure. Their faculty of transmitting vibration more readily was in their favour; it was well understood that in pieces of ordnance and musket-barrels great regularity of proportion in the metal was requisite, in order to insure the equal transmission of the vibration, caused by the sudden expansion of the metal at the moment of the explosion and unless the vibration was regular, the barrel would burst, or the ball would not be correctly delivered.

Mr. Greener, of Newcastle, among other experiments, turned the outside of a musket-barrel to a correct taper, and fixed tight upon it at given intervals several rings of lead, 2 inches in thickness; on firing a charge of 4 drachms of powder, he found that all the rings were loosened, and had all expanded regularly in their diameter.

It was a well known fact that cannon seldom or never burst from continuous firing; such accidents, unless they arose from peculiar circumstances, generally occurred in consequence either of inequality in the nature of the metal or irregularity in its distribution; to the latter cause must be attributed the bursting of the "Mortier monstre" before Antwerp, and of a large gun which was proved at Deal some time since; this latter gun burst at the third discharge, after delivering the ball better than on either of the previous discharges; it was evident that the fracture did not occur under the explosion of the powder, but on the re-entering of the air into the mouth of the gun after the discharge, and also because the thickness of metal was not well-proportioned, whereby the vibration was unduly checked, the cohesion of the molecules of the metal was destroyed, and the gun fell into several pieces, without any of them being projected, as they would have been by the usual effect of an explosive force.

The most practical millwrights were well aware of the superiority of hollow shafts, and they were frequently used, as they were more easily kept cool than solid ones, especially at high velocities, when shafts were peculiarly liable to injury from percussive force, or from a series of recurring vibrations.

THE PLAN OF SMELTING IRON BY STEAM-BLAST has been tried, and failed. "B. G. D." will find it thus alluded to by Sir J. W. F. Herschell in his "Disc. Nat. Phil.:"—

"Instead of employing this power to force air into the furnace, through the intervention of the bellows, it was, on one occasion, attempted to employ the steam itself, in apparently, a much less circuitous manner, viz., by directing the current of steam, in a violent blast, from the boiler at once into the fire. From one of the known ingredients of steam being a highly inflammable body, and the other that essential part of air that supports combustion, it was imagined that this would have the effect of increasing the fire to tenfold fury; whereas, it simply *blew it out*—a result which a slight consideration of the laws of chemical combination, and the state in which the ingredient elements exist in steam, would have enabled any one to predict without a trial."

THE CHINESE PUMPS are in China all worked by *wooden* chains, made of a series of square links; but it does not by any means follow that wood is better than iron; in point of fact, there can be no comparison between them, so far as durability is concerned. Now that the "Iron Barbarians" have enforced a freer intercourse with their "Celestial" friends, we may reasonably hope to see the wooden chains, ere long, superseded by iron of good British manufacture. And when that consummation is realised, it will be only making a fair return to the Chinese for the pump itself, which was the first good one, the world beyond the "wall" ever knew.

MR. NAYLOR'S PHANTASMAGORIA.—Sir,—Having tried the method of constructing the phantasmagoria for the exhibition of moving figures, according to the diagram and statement of your correspondent, T. W. Naylor, in No. 1027, and found it will not answer the representations of Mr. N., I should feel obliged if he would state whether there is any mistake of the printer, or engraver of the diagram. Yours truly, X. Y.

CHROME AND IRON.—To separate these two metals from each other, they are precipitated by ammonia, or carbonate of ammonia, and the humid precipitate is treated by a slight excess of sulphurous acid; all the iron is dissolved, as well as a certain quantity of chrome, and the remainder of the latter metal is converted into pure subsulphite. The solution is boiled until decoloured, and it then contains no more iron; in order afterwards to precipitate this metal from it, the sulphurous acid is driven off, either by means of sulphuric acid, or by means of nitro-muriatic acid, and an alkali, or an alkaline carbonate is afterwards added to it, or else, without decomposing the sulphite, the iron is precipitated by an alkaline hydrosulphate. When a solution of chrome contains at the same time a sufficient quantity of alumina, all the oxide of chrome is carried away by this earth when it is precipitated by sulphite of ammonia. Hence we have a means of separating chrome from iron, manganese, &c. The metals being dissolved, any solution of alumina—alum, for example—is added to the liquor, then sulphite of ammonia is poured in, and it is boiled until it is no longer turbid; it is filtered, and if it still retains its green tint, alum and sulphite of ammonia, &c., are again added to it. The precipitate contains all the chrome, and all the alumina, without any mixture of other oxides; by treating it with caustic potassa, without heat, it is entirely dissolved, but the solution abandons the chrome at the boiling heat, and alumina alone remains.—*Berthier*.

THE PANAMA CHAINS are a remnant of the extraordinary skill to which the ancient Mexicans had attained in works of gold and silver, but are every day becoming rarer and rarer. The mode of making them is said to be kept a secret to this day among the Indians of Panama, Ewbank, who examined one which came from Carthagena, gives the following account of it:—"The length, had it been cut, was 8 feet 2 inches; its section, which was hexagonal, did not exceed one twentieth of an inch in diameter. It was formed of one or more fine wires, which seemed to have been interwoven or interlaced, like the plaiting of a whip handle. When a single thread was examined by a microscope, it was found to be composed of several wires, which, separate, were scarcely perceptible; the weight of the chain was 11 pennyweights, and it appeared to be as flexible as a piece of twine—certainly far more so than any chain formed of links; no end of a wire could be detected, and not a particle of solder was used."

DR. ARNOTT'S HYDROSTATIC BED.—"A Sleep Wisher" states that Plutarch, in his life of Alexander, mentions that the Babylonians used, during the dog days, to sleep "on skins filled with water," and asks whether this does not show the invention to have been old, and therefore vitiate Dr. Arnott's patent? We answer, *first*, that the use of the invention by the *ancient* Babylonians, is no proof that it was ever known to the *modern;* and *second*, that Dr. Arnott never took out any patent. "Sleep Wisher" has, therefore, only to "rest and be thankful."

INVENTION OF ROLLER SPINNING.—The claim of Mr. John Wyatt to the invention which formed the basis of the colossal

fortune of the Arkwrights, was fully discussed in our review of Mr. Baines's History of the Cotton Manufacture (vol. xxii., p. 424). Mr. Baines, and after him, Mr. Barlow, agree with our correspondent, "H. C. C.," in considering that Arkwright but perfected what Wyatt first invented. We have given, in the article referred to, some reasons for being of a contrary opinion. We have shown it to be in the highest degree probable, that Arkwright knew nothing of what Wyatt had previously done—that there is no valid evidence of Wyatt having, in fact, accomplished any thing—and that if any person has a better claim to the invention of roller spinning than Arkwright, it is not John Wyatt, but Lewis Paul.

FILE-CUTTING BY MACHINERY.— Several machines have been contrived for this purpose, but they have been all decided failures. The best files are still those made by hand. Those called "*bastard cut*" are an intermediate, or hybrid class of files, neither rough nor smooth, but something between the two.

THE ATMOSPHERIC PROOF OF GUNPOWDER, consists in exposing equal weights of different sorts to the atmosphere for a number of days, seldom less than fourteen, and then re-weighing them. The increase of weight should not exceed one per cent.; if it is more, the powder is considered bad or indifferent.

THE ARTIFICIAL RUBIES are made, according to Aikin ("Chem. Dic.") by mixing with glass, in a state of fusion, the purple precipitate of cassius, or gold precipitated from a nitro-muriatic solution, together with the oxide of tin. The usual way of making it is to dilute very largely a solution of gold in aqua regia, and add to it, drop by drop, a very dilute nitro-muriate of tin. The liquor immediately becomes of a purplish red colour, and by standing, a precipitate of several varieties of shade slowly subsides.

CYLINDER PRINTING was invented by the late eminent journalist, and ingenious mechanic, Mr. William Nicholson, who took out a patent for it in 1791. The merit of its introduction into use is due, however, to König, who re-patented (and it may be, reinvented) it, in March 1810. The *Times* of November 28, 1814, was the first sheet ever printed in this way. Mr. Cowper, who, in conjunction with Mr. Applegath, invented the improved machines, which have long since driven those of König out of the field, once asked his German precursor whether he was not aware that he had been anticipated by Mr. Nicholson, when König answered that "he made a point of not reading any thing that other persons had done, in order that it might not be said he borrowed from any one!" We meet with this ridiculous sort of affectation not unfrequently among inventors, and would-be inventors, but we have always observed that those who indulge in it most, are those who owe most to their reading, and least to their own ingenuity.

NOTES AND NOTICES.

Chemistry and the Customs.—"As the latest fashion of chemical nomenclature is to convert the German affix *stoff* (stuff) into the Greek ὑλη, whence a great tribe of *yles*, or *ules*, have sprung up in the text books, may I humbly suggest, that in future our Professors in describing the novel naphtha (from New York) the meri's of which Dr. Ure has so admirably exposed, should style it in their next editions, *puranomyle* (or mule), which is by interpretation, *illegal stuff*, in English, and *unrechtmäss-igstoff* in German?"—*A Chemist.*

Cheap and effective Fire Engine for Union Houses and other dwellings.—At a meeting of the Guardians of St. Faith's Union, Norwich, it was proposed by Mr. Thomas Watts, seconded by John Longe, Esq., Chairman, and carried by a large majority,—"That one of Mr. Shalders', jun., six guinea portable fire engines be ordered, and be kept under the Governor's lock, for the security of the building, in the event of fire; and also for employment in the garden, cleaning windows, &c., or for allaying dust." It was also remarked, that in case of a fire in the neighbourhood both engine and help might conveniently be sent to assist.—*Norfolk Chronicle.*—Mr. Shalders informs us that the entire weight of a brass engine, such as referred to in the preceding notice, is only 26 lbs., exclusive of the reservoir steadying stand, and that it can be used wherever a lad 4 feet high can find elbow room; a man working the lever with one hand and guiding the jet-pipe with the other, delivers at a moderate speed eight gallons of water per minute to an elevation, in calm air, of 45 feet, or to a distance of 60 feet. It is not subject to choke or to get out of order, whether it is much used or remains for months idle. Access is had to the hydraulic working parts merely by turning one large screw.

The Turkish Steamer "Peiki Tiguret."—Sir,—Allow me to correct an error in my letter of last week, in your esteemed Magazine, which has arisen, (and escaped accidentally undetected,) either from misstatement or the misapprehension of the individual who furnished the data. The error is, in stating the speed of the *Peiki Tiguret*, to be 15 miles with and 12 miles against tide. It should have been 15 miles with the tide, or 12 miles through the water; her speed against strong tide being somewhat under 10 miles in the hour. I am, Sir, your obedient servant, JUSTICE.

P.S.—On Sunday last, at about quarter before twelve at noon, the *Peiki Tiguret* left Blackwall for the Turkish empire, with some cargo and passengers, and reached Dover at a quarter before six o'clock, making the passage in seven hours. She had a whole tide, it is true, in her favour; still it is an unprecedented result for a sea steamer.—J.

☞ INTENDING PATENTEES *may be supplied* gratis *with Instructions, by application (post paid) to Messrs. Robertson and Co.*

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1037.] SATURDAY, JUNE 24, 1843. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

AMERICAN HORIZONTAL HALF-BEAM BOAT ENGINE.

Fig. 1.

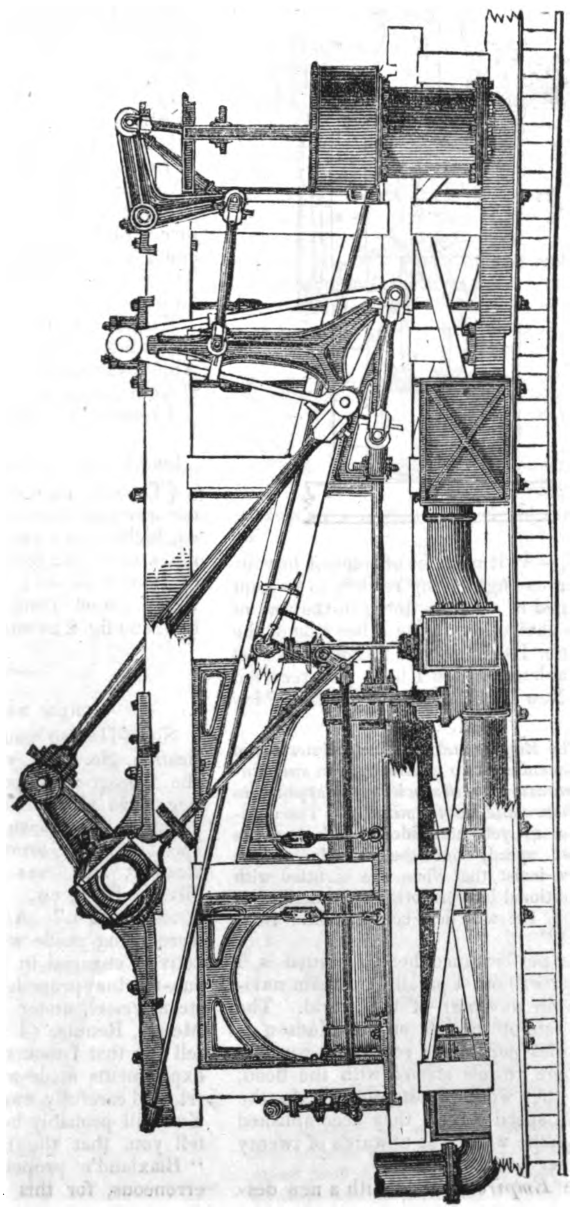
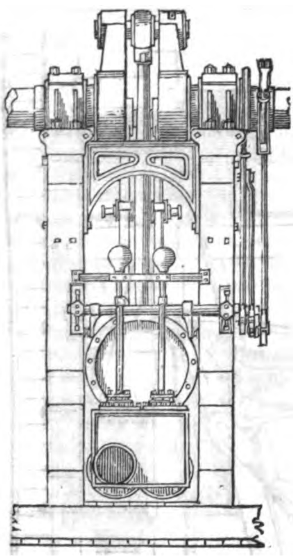


Fig. 2.



Sir,—As it must be of interest to your numerous engineering readers to be kept informed of what is doing in the way of steam navigation on the other side of the Atlantic, I send you the following extract from a letter which I have just received from New York, dated the 29th of May last.

"The *Empire* and the *South America*, in their ascending trip to Albany, ran *one hundred measured miles, without stopping, in four hours and thirty minutes.* The question is, as yet, undecided which has the greatest speed, but the friends of the *Empire* insist that when she is fitted with the additional blowers originally intended to be used, she will defy competition. *Nous verrons.*"

The performance here recorded is, I believe, without a parallel in steam navigation in any part of the world. The usual rate of the tide on the Hudson is two miles per hour; so that, assuming that both vessels started with the flood, which they would most probably do, the rate of speed which they accomplished through the water was upwards of twenty miles per hour.

The *Empire* is fitted with a new description of engine, invented by Mr. W. A. Lighthall, and called, from the most prominent feature in its construction, "The horizontal half-beam boat engine." My correspondent has sent me a set of drawings of it, which I also send you, in order that you, if you think proper, may have them engraved, for the better illustration of the present notice. The cylinders are of 48 inches diameter, *with a twelve feet stroke;* the number of revolutions per minute with steam at 21lbs. pressure, 24 and 25. The *Empire* is the largest boat afloat in America, being 330 feet long, and 50 wide over all. The wheels are 33 feet in diameter, and 13 broad. She makes up 450 beds.

The *South America* is 270 feet long, and is fitted with engines of the ordinary American construction, worked commonly at from 25lbs. to 28lbs. pressure.

I remain, Sir, your obedient servant,

P.

London, June 16, 1843.

[The drawings, with the loan of which our correspondent has kindly favoured us, include two pairs of Lighthall's engines, one of 12 feet stroke, and the other of 10 feet stroke; we give the former. Fig. 1, on our front page, is a side elevation, and fig. 2 an end view.—Ed. M. M.]

SCREW PROPELLING.

Sir,—Having read in your useful publication, No. 1033, your observations on the "progress of screw propelling," I beg leave to be allowed to make a few remarks. You have there stated that the speed of the Government experimental steamer, *Bee*, was with "paddles 7·7; Blaxland's screw, 7·1; Smith's, 6·8; Ericssons, 5·4." At the time these trials were being made with the *Bee*, I was actively engaged in the application of a sub-marine propeller to the *Mermaid* steam vessel, under the direction of the Messrs. Rennie. I need not, therefore, tell you that I took much interest in the experiments made with the former vessel, and carefully watched their progress. You will probably be surprised, when I tell you, that the results attributed to "Blaxland's propeller" are altogether erroneous, for this simple reason, that

"Blaxland's propeller," was *not* that which was applied to the *Bee* at the time 7·1 miles was obtained, and to the best of my belief at any other time. I have before me a copy of Blaxland's specification, dated Nov. 28, 1840; I have also your 982nd Number, wherein I find, in page 45, a correct extract of all that part of the specification which refers to the propeller, and to which I beg to call the attention of your readers. It begins by stating, that "one or more inclined planes or propellers are to be affixed at right angles to a revolving horizontal shaft," and then proceeds to describe the mode of determining the angles at which the inclined planes are to be fixed. The specification finishes with these words, "I rivet the inclined planes, which I prefer divided into three or more parts, each part being separately riveted on to an arm as shown in fig. 7." Now, Sir, it appears clear to me from this description, that what Mr. Blaxland patented was the application of plane flat surfaces, set at angles according to circumstances, and that in order to lessen the bad effect of such an arrangement, he proposed to cut the surface into strips, so as to enable him the more readily to place those parts nearest the centre at an angle which would give them the sa speed horizontally as the parts form the circumference of his propeller. no such propeller as this was used i *Bee* when the 7·1 miles was obtain venture to assert most positively.

Your wish to see what the Bl propeller would do if fitted to th *maid*, has drawn forth these from me, and I have no hesi saying, that if such were the speed of the *Mermaid* would nearer that of the *Swiftsur Railway*. In your remarks that "Mr. Rennie tried sim as in the case of Railways, b was an utter failure." A to inform you that it was a solicitation, and against t pressed opinions, that M permitted the trial of thi quently, the error of judg was mine. I say, "if any still of opinion, that for this principle may be vantage, and nothing accident prevented it *Mermaid*.

I must not conclude without informing your readers what the propeller was that was used by Mr. Steinman, (the proprietor, I believe, of Blaxland's patent,) in the *Bee*. It consisted of four segments of screws riveted to the ends of four arms, each segment being about 20 inches long at the circumference, and about 9 inches in the direction of the arms; the diameter about 3 feet 1½ inch, and its pitch 5 feet; its shaft made 180 revolutions per minute, while the engines were making 40; this shows that there was a step of very nearly one-third. A propeller something like this was applied to the *Mermaid*, but finding the slip very considerable, Messrs. Rennie abandoned it, and fitted her with one of Mr. George Rennie's own, a trial of which was made on Thursday, the 1st instant, when the vessel fully equalled what was expected; showing an increase of speed of the vessel over anything before obtained, with less expenditure of steam power. The speed of the vessel was to that of the propeller as ·91 to 100.

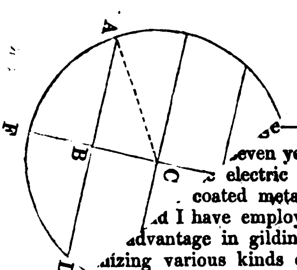
I am, Sir, your obedient servant,

EDWARD HUMPHRYS.

Holland-street, Blackfriars, June 8, 1843.

CASE IN LEVERAGE.

... submit to your intelli- ... (to me) puz-



1842. ...r. Stur- ...same year, ...e— ...even years ago that ... electric machine, by . coated metals with tin, ...d I have employed the same advantage in gilding, silvering, ...izing various kinds of metals of ... value, and I have no doubt that in ... capacity the magnetic electric machine may become generally useful. I have produced good electrotypes on a small scale by its employment."

team, with one horse before the other, the chain or traces having a direct communication with the load; the other contending for the superiority of two horses abreast, whose differing ratios of force might be equalized by the swivel tree; and further, that within a certain range the departure of the swivel tree from the horizontal (meaning a right angle to the line of draught) gave no advantage to either horse. With the latter view I fully concurred at the time, though it was disputed by an eminent practical agriculturist; but on reconsidering the subject, and from what I have said above, the position would seem untenable.

If I mistake not, that beautiful and apparently correct contrivance, the Dampier balance, is based on the principle—whatever it may be—on which the difference between the two cases turns. If this be the case, and if its maximum of excellence be in the range nearest the horizontal, while at the vertical position of the weighing body, all discrimination must be totally lost, then—*Query*, if throughout the entire range it does not become approximatively or progressively imperfect?

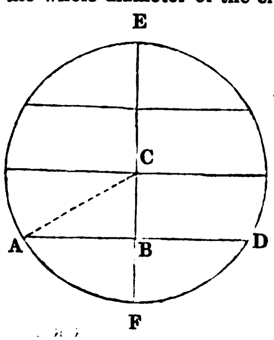
I remain yours, Sir, an humble and sincere enquirer after truth,

SAM. PHILLIPS.

CONSTRUCTION OF BEE HIVES.

Sir,—Wishing to make two bee hives of peculiar dimensions, being segments of spheres, the following problems were required to be solved.

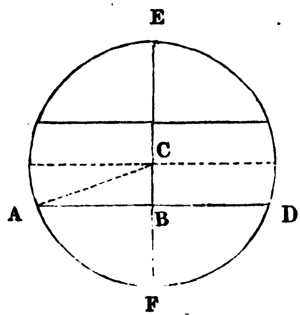
First. Given the chord A D of an arc of a circle = 12 inches, to draw a circle, so that the versed sine, B F, of the segment which the chord cuts off from the circle shall be equal to one quarter of the whole diameter of the circle.



A B = ½ of A D or 6; and C being the centre of the circle, let x = B C, and as B C is = ¼ of the diameter E F, therefore A C will be equal to 2 x, being the radius. Then let a represent A B = 6, and we have the following equation:

$a^2 + \overline{x^2 = |} = 4\,x^2$; by transposition, $a^2 = 3\,x^2$. Again, $x = \sqrt{\frac{a^2}{3}}$, and as

$a = 6, a^2 = 36$; therefore $x = \sqrt{\frac{36}{3}} = 3{\cdot}46$ in.



which is = B C, or ¼ of the diameter of the circle A F D E; consequently, the diameter will be 13·84 inches. And from the foregoing we have the following

First General Rule.

Divide the square of half the given chord by 3, and extract the square root of the quotient, and the result will be the versed sine of the segment of the circle which the chord cuts off, which, being one quarter of the whole diameter, must be multiplied by two or four for the radius or diameter.

Second. Given the chord A D of a circle = 12 inches, to find the diameter of a circle, so that the versed sine, B F, of the arc which the chord cuts off shall be equal to one-third of the whole diameter of the circle.

Let x = B C, which is = ⅙ of the diameter E E. Then A C will be = 3 x, being the radius; therefore we have in the triangle A B C the base A B = 6, and the perpendicular represented by x and the hypothenuse A C = 3 B C, or 3 x.

Then 6^2 or $36 + {}^2 = \overline{3\,x^2} = 9\,x^2$; by transposition $8\,x^2 = 36$ or $x^2 = \frac{36}{8}$

Therefore $x = \sqrt{\frac{36}{8}} = \sqrt{4{\cdot}5}$ inches. Hence

B C = 2·12 inches multiplied by 6 = 2·72 inches E F the diameter. From which we have the following

Second General Rule.

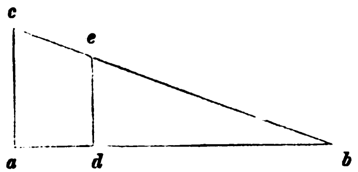
Divide the square of half the chord by 8, and extract the square root of the quotient, and the result, multiplied by 2, will give the versed sine of the segment of the circle which the chord cuts off; and that product, multiplied by 3, will give the diameter of the circle.

Yours, &c.,
W. S. Jr.
A Member of the Darlington Mech. Inst.

SCREW CUTTING.

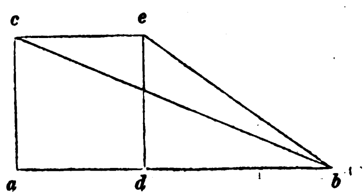
Sir,—In your Number 1029, page 360, there is an enquiry by "Light" respecting screw-cutting. The following will, I hope, be sufficient information for him.

Fig. 1.



Let the line *d b* represent the circumference of the smaller screw, stretched out into a straight line, and *a b* the length of the circumference of the larger screw; and let *a b c* represent the angle which the worm, when uncoiled, makes with the base or circumference stretched out as above: then it is evident that the distance travelled over by the smaller screw in one revolution will be represented by the perpendicular *d e*, and the distance travelled over by the larger screw in one revolution will be represented by *a c*. This proves that two screws of different diameters, cut by the same die, cannot correspond with each other, for the larger travels farther than the smaller at each revolution in the ratio of *a c* to *d e*.

Fig. 2.



To cut screws of different diameters, whose rates shall be equal, it will be necessary to make the angle *a b c* of the larger screw smaller than the angle of the smaller screw, as follows; let *d b*, fig. 2, be the circumference of the smaller screw; *a b*, that of the larger; *d b e*, the angle which the worm of the smaller screw makes with the base; and *d e* the distance travelled over by the smaller screw in one revolution; make the perpendicular *a c* equal to *d e*, and draw the line *c b*, then the angle *a b c* is that at which the worm of the larger screw must be cut; and conversely, if the angle *a b c* of the larger screw be given, the angle *d b e* will be that at which the worm of the smaller must be cut. I am, Sir,

Your obedient servant,
JOSHUA JEAYS.

ABUSE OF THE PATENT LAWS—ROBERTS'S GALVANIC BATTERY—NEW DIAPHRAGM.

Sir,—A most absurd practice appears to have become common amongst certain individuals—a practice, the continuance of which will offer serious obstacles to the freedom and progress of scientific investigation and discovery. With your permission, I wish to call the attention, and, if possible, procure the assistance of yourself and of your readers, in endeavouring to arrest the progress of an evil of no small magnitude.

I refer to the numberless instances in which parties obtain patents for inventions to which they have not the slightest foundation of a claim—such discoveries having been previously made known for the benefit of the public. I was particularly struck with this fact in reading the account which you gave, a few months since, of a patent taken out by a Mr. Woolrich, of Birmingham, for gilding, plating, &c., by means of the magnetic electric machine. The patent was obtained in the latter end of the year 1842. Now, in a work published by Mr. Sturgeon in the early part of the same year, occurs the following passage—

"It is now more than seven years ago that I contrived a magnetic electric machine, by means of which I coated metals with tin, copper, &c.; and I have employed the same machine to advantage in gilding, silvering, and platinizing various kinds of metals of inferior value, and I have no doubt that in this capacity the magnetic electric machine may become generally useful. I have produced good electrotypes on a small scale by its employment."

Here, sir, is the very invention particularly described and practised, for which, some months after, Mr. Woolrich obtains a patent, and I, along with others, who have practised or intend to make use of the plan proposed by Mr. Sturgeon, have the satisfaction of seeing the patentee step in, with "Stop! where is your license?" If Mr. Woolrich had made some ingenious improvement in the magnetic electric machine, and then, from its superior utility, laid a claim for its application to electro-metallic purposes, our surprise might not have been much excited; but when he gives a description of the usual form of that machine, and then claims its appropriation to gilding, plating, &c., as an invention of his own, after Mr. Sturgeon had published it for the benefit of all, it is assuredly a case of self-appropriation which one may be well excused for not submitting to.

It is especially in connexion with the subject of electro-metallurgy that this abuse exists. There is scarcely one of the ingenious inventions and devices introduced by Mr. Spencer and others, which has not been patented by other parties, thus committing, I may say, an act of robbery on the public, and of injustice to the original inventor. Imagine, sir, the surprise of Messrs. Daniell, Grove, and Smee, if a patent were to be obtained next month for the various voltaic arrangements invented by those gentlemen; or how would General Pasley sustain his gravity if a patent were to be granted for exploding gunpowder, or other *analogous* material, by means of a wire ignited by the voltaic battery. Yet such things may be. Mr. Spencer's avowed object was to obtain a metallic surface for printing, &c., but this part of the invention is now monopolized by patent. The same individual also discovered a method of causing the voltaic deposit to adhere by means of nitric acid, yet another person has the "coolness" and folly to claim the device as his own, by procuring a patent for it. Mr. Charles O. Walker discovered a plan of plating and gilding with silver and gold anodes, thus effecting a great reduction in the expense of these processes, and almost immediately after a patent, of course, is granted to another individual for the use of those discoveries. More than one patent has been obtained for modification of the voltaic battery, whilst the science of photography is enveloped on every side by these protecting influences. Endeavour to conceive to yourself, Mr. Editor, the learned philosopher, Volta, securing the right to use the invention which bears his name, by obtaining a patent in every country in the world for the voltaic trough; or suppose that every lightning conductor were to be dubbed with "Benjamin Franklin, Patentee." At the meeting of the British Association, Mr. Fox Talbot gave to the public, as I had ignorantly supposed, a plan of multiplying specula by the electrotype, stating, at the same time, that two other individuals had practised a similar invention; but some months after, the above plan, so generously given *pro bono publico*, is returned to its lawful owner by means of a patent. Truly there is something comprehensive and universal about these patents which ought to excite our admiration and wonder. I would sincerely recommend Mr. Thomas Spencer to obtain a patent (and who shall hinder him?) for making cupreous deposits for any and every purpose whatever, by means of a current of electricity, steam, or other *analogous* fluid, and to improve his undoubtedly original invention by including amongst his deposits every metal under the sun, save and excepting *brass*, the monopoly of which he may safely and profitably leave to his successors in the electric art, or "cold metallic foundry," as Jacobi has it.

No doubt you will have seen the account of the grand explosions near Dover, by the use of the voltaic trough, and as you have previously recommended for that purpose the form of battery proposed by Mr. Roberts, I wish to take this opportunity to caution your readers from using an arrangement which, in my opinion, is injudicious. I am led the more to allude to the subject, because, probably, like many others, I relied on his supposed experience, and, without much reflection on my own part, constructed a rather extensive battery on the plan proposed, and was considerably mortified with its failure. The error does not exist in the materials employed, which are zink and iron, which elements promise to be of great utility, though I am inclined to believe they were first proposed by Mr. Sturgeon; but the fault lies in the arrangement of the two metals. On reference to the plan, as depicted in

your last year's Magazine, it will be seen that each zink-plate is connected with an iron plate; only, by a peculiarity in the arrangement, there is interposed between every zink and iron plate so connected, two other plates of the same series. It is well known that when a zink and iron, or other similar plate, are connected together, and then immersed in dilute acid, the zink-plate is rapidly dissolved, a current of the positive galvanic fluid passing from the zink through the liquid to the other plate. Mr. Roberts's idea seems to be that by placing two other plates between the zink and iron, which are joined together, the galvanic fluid would be arrested without the use of partitions, as usual; but as the interposed plates are good conductors of the galvanic fluid, such an idea is fallacious, and as soon as the battery is immersed in the acid, action commences, and in a short time the zink plates would be destroyed without having been used at all. It is on this principle that I have made use of a diaphragm for separating the two fluids in Daniell's battery, and in some others, where such diaphragms are required. A multiplicity of substances have been proposed for this purpose, amongst which most commonly used are animal membrane, bladder, brown paper, plaster of Paris, wood, and porous earthenware, the whole of which have some defect or other, which is a source of trouble to the operator. Now I find that a metallic diaphragm surpasses by far every other, preventing, as it must do, the least mixture of the fluids, and, at the same time, allowing the galvanic fluid to circulate without any obstruction at all, a desideratum not obtainable with any other form of diaphragm. When the fluids have no action on copper, I prefer to use it as the substance for the diaphragm; but when nitric acid is used, as in Grove's battery, I employ copper, gilt or platinated on the side of the nitric acid, or else use a cast-iron diaphragm, on which material the nitric acid has but little effect. The only precaution requisite in using a metallic diaphragm is to prevent it from coming in contact with the zink or copper, &c., of the arrangement, in which case, of course, a local circle would be formed, and the general effect would be lost. I remain, Sir,

Your obedient servant,

C. W.

[The increasing number of conscious and unconscious appropriators of other men's inventions is doubtless becoming a crying evil; but perhaps it can be put down in no way so effectually as by such public exposures as the present. The improvement in Mr. Roberts's battery, which we published last week, appears not to have come under the notice of our correspondent at the time he penned his present communication.—Ed. M.M.]

HOW TO SAVE A VESSEL WHICH HAS SPRUNG A LEAK, FROM SINKING.

Sir,—When a vessel at sea has sprung a leak, I beg to suggest that she should be treated the reverse way of what is customary. Instead of pumping out the water, attempts should be made to render her decks air-tight, and to force in air from an air pump, which would drive out the water by the aperture it entered: when the water has sunk below the level of the leak, the position of the latter would be shown by the escape of air on one side, thereby facilitating any efforts to stop it.

Many vessels, if not deeply laden, would, I apprehend, contain plenty of air without forcing any in to exclude sufficient water to sink them, if the decks were instantly made tight on the discovery of a leak, so as to retain the air already within, before its displacement by water.

A ship disposed to take fire by the spontaneous combustion of her cargo, would be out of danger if exhausted by an air-pump of the air or gas generated; or a ship on fire in the hold, would be saved from destruction by the same means.

Among your numerous nautical readers are some, no doubt, who will be so obliging as to state if any, and what obstacles exist to the adoption of the above system for the protection of life and property; the only requisites being the possession of an air-pump, and easy means of assisting its operation.

I am, Sir,

Your obedient servant,

H. Walker.

20, Maiden-lane, Wood-street.

Fig. 2.

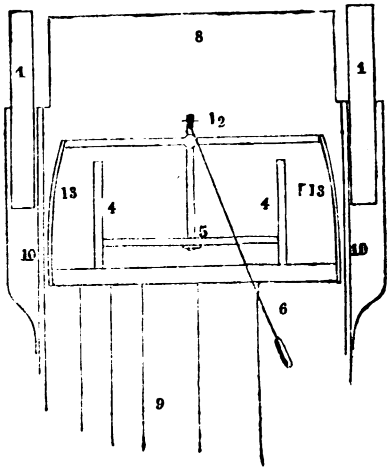
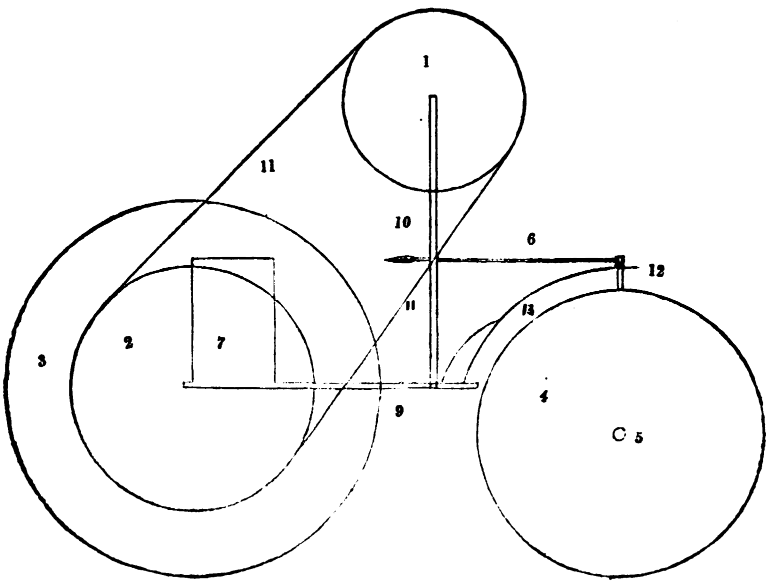


Fig. 1.



Sir,—The above is a sketch of a manumotive carriage which I have invented and constructed for the purposes of exercise and pleasure. It is drawn upon a scale of half an inch to a foot. It may be constructed so as to contain one, two, or three people.

Two power drum-wheels, 1 1, are connected by leathern straps to drum-hoops, two upon the spokes of the driving wheels 3; 4 4 are the guiding wheels, two of them for steadiness; 5 is the axle of the guiding wheels, coming up through a cross iron bar 12, supported by shafts 13 13;

6 is the tiller; 7 is the seat whereon the winch handle 8 (fig. 2) is worked; 9 is the floor of the carriage 3 feet wide and 3 long, without the shafts; 10 10 are the supports for the power wheels; 11, the straps.

The exercise is like that of rowing in some measure, and the speed, on level ground, between seven and eight miles an hour.

If you think this account will interest your readers, as much as your Magazine is a source of great pleasure to me, I shall feel much gratified in your making it public.

A modification of the plan can be made to suit children, or a single person. Its power is great, and the principle extremely simple.

The winch-handle may be separated into two, and the driving wheels may turn as a gig's wheels do. In my carriage, however, they are fixed.

I remain, Sir, yours sincerely,

GEORGE H. HEATHCOTE, M.D.

70, Mount Pleasant, Liverpool,
June 3.

MANUMOTIVE CARRIAGE.

Sir,—Having brought my locomotive carriage before the public by your kind assistance, and given a full description of all its parts in the April Part of your valuable periodical, the subsequent appearance of Mr. Griffiths' passenger-propelled carriage in the Part for May, has induced me to enter into their comparative merits. In doing this, I am not influenced by any ostentatious pride or the love of popularity, but simply by the desire of establishing the best principle in the construction of such machines. Whether they may ever become available as a medium for useful travelling and intercommunication, I will not venture to predict; although, at the same time, I cannot help thinking, that their adoption upon rail roads or tramways, might possibly prove publicly useful, and afford a safe, easy, and even comparatively expeditious means of communication, especially to the invalid or timid, who have an abhorrence of steam conveyance. The relative position in which I stand with regard to a gentleman like Mr. Griffiths, who is by profession a mechanic, is sufficient to give me a just sense of my own humility in approaching him upon a subject of which he must necessarily be a perfect master; but although a legitimate in my own profession, I confess I am but an empiric in mechanics, who can boast no more than an ardent love for it: with this apology for my intrusion, I have no doubt, Mr. Griffiths will excuse any remarks I may make upon any imperfection that may seem apparent in his carriage, as I am satisfied that he is equally disinterested as myself in giving publicity to his ingenious invention. Facts are incontrovertible, and the circumstance of Mr. G.'s carriage attaining such a high velocity as represented, would at once show that it had acquired a high degree of perfection in its construction.

It is quite certain that the inventor starts with the very best, and indeed, only true principle, that of a "continued rotary motion produced by the weight of the body;" but the application of the power and working parts to two wheels is objectionable, not so much because it adds to the weight, complication and expense of the machinery, or because of its entailing additional friction, but because it leads to the necessity of adopting his ingenious mode of turning, and thereby adds still more to the expense and weight; and also, because, from the certain risk there is of displacing or straining the machinery of each wheel from leverage, by the continual weight of the body acting on the central part of the axle, especially when the wheels are far apart, (that is, if there be much width of axle, which should be the case to make the carriage accommodating,) it would require to obviate this, that the machinery should be very strong, and therefore heavy. Now, if instead of applying the power to *both* wheels, he would adopt the same arrangement with *one* wheel only, stationed in the centre of the carriage, then there would be no strain or risk of displacement, the weight would be steadier, and the necessity for the adventitious arrangement of turning, would be superseded and entirely dispensed with. The carriage would then turn in its own compass like any other, like an eel, as it were, with the carrying or travelling wheels on their own short axles. I once had adopted this plan, but discarded it for the purpose of reducing the weight, and substituting the slipper on the crank, placed at *less* than an op-

posite angle with respect to each other, when they were always in a position for acting, and the centre of gravity thereby much easier overcome. Were Mr. Griffiths' arrangement adopted after this manner to a single carriage, or for the conveyance of a single person, even with one guiding wheel, it would answer well, and no doubt, would ascend hills with tolerable facility. But if it is to be made available for two or more passengers or persons, *another* arrangement must be effected. The machine must be guided by *two* wheels instead of *one* (which at best is unsteady and unsafe), for as a single conveyance, it is selfish and unsocial, and may, with propriety, be termed "a Sulky." The second, or additional passenger, ought however, to contribute something towards his locomotion or self-propulsion, and not "eat the bread of idleness." And here the plan adopted in my carriage, becomes necessary as an auxiliary with the chain embracing the circumference of the main and working wheel as delineated in the published design. Under these circumstances, the person who works the tread, or the crank, and also the auxiliary helper, turn their backs on the guiding-wheels, which are, of course, entrusted to the former, as in the other case of the single one. Along with these combinations, the wind is called into aid, and from whatever point it blows it becomes available in the progression of the vehicle. The guiding arrangement adopted in mine is such as renders it entirely and easily under the control of the operator, and was the most difficult thing of accomplishing. I have little hesitation in saying, that with such disposition of machinery as now suggested, and especially upon a tramway, or possibly upon a single rail laid down for the traversing of the centre-working wheel (for that purpose grooved), a very high velocity might be attained, with comparatively little labour. I cannot help thinking, that such a scheme would lead to profit and much pleasure, if adopted near large towns and celebrated watering places.

I cannot, however, take leave of this subject, without stating, (and I am warranted in doing so from my experience at least, for I would not say scientific attainments,) that Mr. Griffiths' principle ranks amongst the foremost of all the locomotive designs I have ever seen: with regard to my own, I would say, that its speed and little labour of propulsion have been most satisfactorily proved.

I have the honour to remain, Sir,

Your very obedient servant,

P. WILLIAMS.

Well-street, Holywell, 1843.

MR. CRADDOCK'S STEAM-ENGINE IMPROVEMENTS—(SEE MECH. MAG. VOL. XXXVI. P. 246.)

Sir,—As one of the means by which I greatly economise the use of steam is by using it of high pressure, and that expansively, and as it does not seem to be admitted generally that the advantages of high pressure steam are by any means as great as I may be disposed to consider them, I beg to be permitted to lay my views on the subject before your readers, in as plain a way as I can, and if I am wrong, I shall be obliged to any one, who, in a friendly way, will set me right. In what I am about to state I make no pretensions to any thing new; I shall only put old principles in a new, and, perhaps, more intelligible form.

In the first place, it is I believe, an established truth, that a pound of steam at all pressures contains the same quantity of heat—the latent heat diminishing as the sensible heat increases. Let us then take a pound of steam, and 1000° of heat, as the quantum which is necessary to keep it in the form of steam. We have here two fixed quantities applicable to all pressures. The next step is to make quite sure that we do not give a greater volume to the pound of steam with its 1000° of heat, than it really has at all these pressures we are about to treat of. For the sake of simplicity I shall take no notice of the increase of volume as the sensible heat increases, as shown by Dalton, and others (which, perhaps, in practice, with proper clothing of the cylinders and steam pipes, may be nearly, if not quite equal, to that lost by condensation). But I shall take the volume at 15 lbs. on the inch, (which would be 1,669 times the volume of the water from which it was produced,) and divide this volume by 8 to give us the volume at 120 lbs. on the inch, which, neglecting the fraction, would be 208 times the volume of the water that produced it. Now, if we suppose no loss of heat or

steam to take place, it is clear that the 208 inches at 120 lbs. pressure will be equal to 1,669 inches at 15 lbs. pressure; for to say it would not be so, would be a contradiction. If we now take four cylinders all of the same length, and assume that the first receives the steam from the boiler at 120 lbs., having one square inch in its piston, then the steam on its entering the second cylinder will be of 60 lbs., and its piston have two square inches in it; on its entering the third cylinder, it would be at 30 lbs., and its piston would have four square inches in it; on its entering the last cylinder it would be only 15 lbs., and its piston would have eight square inches. I would here remark, that I have commonly found it stated, that to carry out the expansive action of steam to any thing like this extent, would be impracticable, except for pumping water or such like purposes, where great irregularity of motion was not of material consequence. But with all due deference for this opinion, and those who hold it, I must beg leave to express my dissent. I do not see why the engine may not be as uniform in its action on this principle as without expansion at all; for if we take four vessels, or boilers, the first is that in which the steam is generated, while the other three serve to receive the steam from the cylinders in succession, and transmit it from the smaller to the greater. In this way, as uniform a pressure may be obtained on each piston as if it were being generated from the water in each vessel, at the respective pressures, viz. 120, 60, 30 and 15 before stated. It may be as well to observe, that as the steam comes from one cylinder it would be going into another, so that the vessels would not require to be large to prevent variations of pressure. In this case, all that would be required in three of the vessels, would be to keep them a little hotter than the steam, which may be done by the hot air from the first boiler being carried round them, before it escapes up the chimney. We should thus get the mechanical effect produced by the four cylinders with the same quantity of heat and water as would be used in the last cylinder, only at 15 lbs. to the inch.

Let us now enquire what would be the difference or gain by using steam at the commencement of 120lbs. pressure per square inch with four cylinders, such as described, when compared with commencing at 15lbs. only, and working through the last cylinder. We have then four pistons against which the steam acts, the areas of which are respectively as 1, 2, 4, and 8, whilst the force of the steam is 120 lbs., 60 lbs., 30 lbs., 15 lbs. It is now material to state the resisting pressure against each of the pistons, which would be nearly thus, 60, 30, 15, 0. In the last case, I suppose a perfect vacuum. We have then, as regards the first piston, to subtract 60 from 120 which gives us 60 lbs. available force or power, including friction. In the second case we have the same amount, as there we have double the area of piston, and 30 lbs. effective force of steam. In the third we have only 15 lbs. effective force of steam, but, on the other hand, we have 4 square inches area, which is 60, as before, available power. On the whole, therefore, we have three times 60, or 180, available power, including friction.

We come now to steam of an atmospheric pressure, or 15 lbs. on the inch. Here we have an area of 8 square inches, and no resisting pressure, which is equal to 8 times 15 lbs., or 120 lbs., available power, so that what we have gained is 180; for it must not be overlooked, that had this steam come direct from the boiler at 15 lbs., instead of working through the other three cylinders, it could not have produced, without further expansion, any more effect than 120 lbs. The gain then is as 300 to 120 by thus using steam expansively. To avoid obscurity, and prevent mistake, I have taken the volume of steam at 120 lbs. as the ⅛ of what it is at 15 lbs., but the correct volume at 120 lbs. is 251 times the volume of the water that produced it, and not 208, as I have assumed. I have also supposed the case of four cylinders with the connected vessels, merely to show how steam may be used expansively to any extent, and yet be perfectly uniform in its action. But for most, if not all practical purposes, I believe that two cylinders, of short stroke, and consequently quick succession of strokes, with the steam cut off at any desired part of the first cylinder, better than the four, and should prefer the steam coming direct from the first cylinder to the second, without any intervening vessel, as in this way the gain would be greater, because it would impinge on the second piston, which would

have the greater area, with a much greater force at the commencement of the stroke. I have also fixed on 120 lbs. to commence with, because it afforded me an easy divisor. I am, Sir, yours, &c.

THOMAS CRADDOCK.

350, Coventry-road, Birmingham.

SUPPLEMENT TO MR. STERLAND'S METHOD OF COMPUTING COMMISSION, BROKERAGE, ETC.—(SEE MECH. MAG. NO. 1023, P. 220.

A simple and concise *method* of computing (within one halfpenny) a *half year's dividend* on any amount of *stock* in the public funds, &c.

Rule.—Multiply the *stock* by the rate per cent. Take the unit of the pounds for the *pence*, and the figures on the left hand of it, for the *shillings*.

Thus, the half year's dividend on £281 1*s.* 2*d.* in the 3 per Cents., which being multiplied by 3 makes £843 3*s.* 6*d.*, is 84*s.* 3*d.*, or, £4 4*s.* 3*d.*

But when this *unit* is more than 4, and when the *shillings* are more than 5, then *one penny* must be added to the result for each unit and fraction.

Thus, on £281 13*s.* 4*d.*, which being multiplied by 3 makes £845, is 84*s.* 5*d.*, or, £4 4*s.* 5*d.* Add 1*d.* for the *unit* being more than 4, and it is then £4 4*s.* 6*d.*

On £281 1*s.* 2*d.* in the 3½ per Cents., which being multiplied by 3½ makes £983 14*s.* 1*d.*, is 98*s.* 3*d.*, or, £4 18*s.* 3*d.* Add 1*d.* for the *shillings* being more than 5, and it is £4 18*s.* 4*d.*

On £281 18*s.* 2*d.* which being multiplied by 3½ makes £986 13*s.* 7*d.*, is 98*s.* 6*d.* or, £4 18*s.* 6*d.* Add 1*d.* for the *unit* being more than 4, and 1*d.* for the *shillings* being more than 5, and it is then £4 18*s.* 8*d.*

This method may be considered sufficiently accurate for the general purposes of the public; but I am aware it cannot be adopted by the clerks in the Bank of England, because Government never pay the smallest fraction *more*, (although they frequently pay *less*) than the *true* computation.

The annual dividend paid half yearly at the Bank on 5*s.* 7*d.* stock in the 3 per Cents., is *two pence*, but on 5*s.* 6*d.* stock no dividend at all is paid. The Bank pay the same half yearly dividend on £287 15*s.* 6*d.* as on £287 10*s.*, viz.—£4 6*s.* 3*d.*

Margate, June 13, 1843. J. STERLAND.

"PHOTOGRAPHIC MANIPULATION."*

Mr. Palmer, of Newgate-street, who has taken so prominent a lead among instrument makers in all that relates to the modern arts of electro-metallurgy, photography, and glyphography, (the last an invention of his own, of which we shall presently take an early opportunity of giving our readers some account,) has just published a most needed, very cheap, and very useful little work under the above title. It is stated to be the "first literary attempt" of the writer, and, so far as "literary" talent has any thing to do with the matter in hand, is creditable enough to his pen; but the real value of the work consists in its being a plain and correct compendium of the elementary information necessary for the guidance of a person desirous of cultivating the photogenic art, drawn up from authentic sources by an intelligent hand, under the superintending eye of one of its most zealous and skilful practical cultivators, Mr. Palmer. Photogenic drawing, as our readers need scarcely be informed, includes both the daguerreotype and the calotype—the former the invention of M.M. Daguerre and Niepce, of France, and the latter that of Mr. Fox Talbot, of our own country. We select, as a specimen of the work, the author's description of the Daguerreotype process, not only because it is a fair specimen, but because it furnishes, at the same time, the required answer to an enquiry recently addressed to us on the subject by our esteemed correspondent, Mr. T. H. Pasley, of Jersey.

"Daguerreotype Pictures, as they are called, are taken on copper-plates, covered with a coating of silver, which should be as pure as possible, and of sufficient thickness to allow of its being very finely polished. A superior description of Sheffield plate is the kind generally used, which, after being cut to the sizes required, is flattened or planished by the hammer, and afterwards polished on a lathe to the required surface. These plates, properly prepared, and cut to any size, can be obtained ready for use.

"The most improved method of pro-

* "Photographic Manipulation; containing Simple and Practical Details of the most Improved Processes of Photogenic Drawing, the Daguerreotype and Calotype. Illustrated with cuts of the various Apparatus." Palmer, Newgate-street, 1s. 6d.

ceeding consists of five distinct operations, viz.—

"1. Cleaning the silver plate.

"2. Rendering its surface sensitive to light, by exposing it to the vapour of iodine, bromine, or their combinations with chlorine, &c.

"3. Exposing the prepared sensitive plate to the focus of either a refracting or reflecting camera.

"4. Bringing out the picture by exposing it to the vapour of mercury.

"5. Setting the picture, by removing the sensitive surface of the plate which has not been acted upon by the light.

"1. *Cleaning the silvered plate.*—The object in this operation being to obtain a surface of silver, perfectly pure and polished, it is of the greatest consequence that the articles used should be free from grease, or any other substance of an oily nature. It is also advisable that the plates be not prepared in any place where vapours may exist, arising from acids, volatile oils, &c.; as regards the importance of attending to this suggestion it may be noticed, that a small quantity of oil of turpentine having been used in a room where some Daguerreotype plates were afterwards polished, prevented any good pictures being obtained till its odour had entirely disappeared. Many ways and substances have been proposed for giving the best surface and polish; but the following can be recommended for its simplicity, and the good result obtained.

"The articles necessary for this operation are,

"Cotton wool.

"Calcined tripoli.

"Prepared lamp black.

"Olive oil.

"Nitric acid diluted with about seven parts by measure of water.

"Spirit lamp and stand.

"Pair of pliers.

"Cotton velvet buff.

"The cotton wool should be clean and free from any greasy substance, and if any difficulty is experienced in obtaining it so, it is best to prepare it by soaking for about an hour in a rather weak solution of ammonia (hartshorn), and after thoroughly washing in clean water, allowing it to dry before the fire, or in a moderately heated oven.

"The calcined tripoli, which should be in the state of an impalpable powder, is best kept for use tied up in a small muslin bag, and protected from dust in a wood or paper box.

"The lampblack should be prepared by making it red-hot, in a crucible, till vapours cease to arise from it; the crucible should then be removed from the fire, closely covered up and allowed to get cold. The lampblack thus burnt, should be reduced to a fine powder in a glass or porcelain mortar, and a portion tied up, like the tripoli, in a small bag of very fine muslin.

"*The mode of proceeding is as follows.*—Lay the plate, silver side upwards, upon a piece of clean white paper, or, what is more convenient and better, on the plate holder, (see list of apparatus,) and shake a small quantity of the tripoli over it; a few drops of olive oil should then be applied, and with a knot of the cotton, and a light hand proceed to polish the plate by a series of circular movements, equally over its surface, adding more tripoli as required. The time usually expended for producing a good surface on a new plate, is about five minutes. If the plate be one that has been used, it should be heated over a spirit-lamp for a short time before beginning to polish; when a good surface is obtained, take a fresh pledget of wool, and shaking more tripoli over the plate gradually wipe off the oil, using a fresh piece of cotton as required: when the whole of the oil is apparently removed, the plate ought to be heated over a spirit-lamp to the temperature of about 300° Fahr. for half a minute; it may then be allowed to cool; when cold, apply by means of a piece of cotton wool, a few drops of the dilute nitric acid over the plate, which will immediately indicate if it has been sufficiently heated by its flowing easily over its surface, without running into distinct globules, which it would otherwise do; if the acid wets the surface easily, dust a little tripoli over it and with a fresh piece of cotton wool dry the acid off in the same manner as you did the oil; if the acid does not adhere to the plate, it will require to be rubbed with the tripoli for a little longer time before drying it off.

"For giving the plate its final polish, dust a little of the prepared lamp black on the velvet rubber and briskly polish, holding the plate, if a small one, on the ends of the fingers of the left hand and using the buff with the right; if a large plate, place it face downwards on the rubber, moving the plate up and down by means of the fingers, with a slight degree of pressure, taking care that for portraits the movement should not be in the direction of the face, but across it; and for views, in the direction of the view; and it is also best for this last polish to be given in a rather dark room, or by the light of a candle, as the clear daylight affects the bright surface of the silver, injuring its sensibility.

"*Applying the Sensitive Coating.*—When the plate is well polished it will appear perfectly black, on looking at it in a certain angle; and just before proceeding to expose

it to the fumes of iodine, be careful to remove every particle of dust or tripoli from its surface, by a piece of the prepared wool, or a very soft camel's-hair brush; if this be not attended to, a number of black specks will be seen on the plate when iodined.

"The operation of iodizing divides itself into two parts. 1st, Iodizing, properly so called. 2nd, Exposure to the vapour of chloride of iodine, bromide of iodine, or bromine.

"1st. *Iodizing.*—This is accomplished in the best manner by an apparatus called the iodine box, described in *list of apparatus.* A small quantity of a solution of half an ounce of pure iodine, in about an ounce and a half of sulphuric ether, should be poured over the card at the bottom of the box, and spread evenly over its surface with a soft brush; in a few seconds the ether evaporates, leaving a coating of iodine. If not used immediately the plate of glass placed over the card will, in a great measure, prevent the useless evaporation of the iodine.

"*To iodine the plate*, remove the lid and plate of glass, and place it, face downwards, on the ledge for that purpose, on the top of the box; in about a minute or two, according to the temperature, the plate will become of a fine orange yellow colour; it is as well to examine it several times during this operation, to see that the iodine is spreading evenly over its surface, as it will sometimes happen that the evaporation will proceed more rapidly from one part than another; in this case the plate should have its position altered from time to time, that an even coating may be obtained over its surface.

"This operation is best done in a dark room, by the light of a candle; but if any difficulty be experienced in getting the proper colour on the plate, it can be done in a room not having a direct, but diffused light; as for instance, a room having the window-shutters closed and the door opened, just sufficiently to allow you to see. The colour of the plate is observed by holding a sheet of white paper in such a position, that its reflection may be seen on the plate, which will enable you to judge of the progress of the operation; if not sufficiently coloured, return the plate immediately to the iodine box till the proper tint be obtained. The plate thus prepared should be shut up in a dark box till wanted for use, when it must be subjected to the next operation, viz.—

"2. *Exposure to the Vapours of Chloride of Iodine, Bromide of Iodine, or Bromine.*—All of these articles, separately, and their compounds, have been recommended at different times by various persons, for giving to the plate its greatest degree of sensibility; but the most simple and effective compound, according to the latest experiments on the subject, appears to be 'bromide of iodine', which is prepared for the purpose in the following way:—Dissolve one drachm of iodine in four ounces of alcohol, and add to it about one ounce of an aqueous solution of bromine, or till the mixture becomes of a fine red colour. The bromide of iodine thus prepared, can be kept in a stoppered bottle till wanted for use.

"When a plate is about to be prepared, two drachms of the bromide should be mixed with eight ounces of water,* and this solution, when used, should be poured into the *bromine glass* till it occupies about two-thirds the depth of the lower division, taking care that no portion of the glass above the level of the liquid be wetted by it, as that would give an unequal coating to the plate.

"The silver plate iodined of a clear yellow colour, as described under iodizing the plate, should be placed (face downwards) over the bromine glass, just resting on the ledge for that purpose. The plate should remain exposed to the bromine vapour from one to five minutes, or till its surface becomes of a decided rose tint, taking care to notice the exact time requisite to produce that effect. The plate may then be returned to the dark box, and is ready to be exposed to the luminous rays in the camera.

"Great care should be taken in observing the colour of the plate, while being exposed to the bromine, as the plate gradually becomes exceedingly sensitive to the action of light, till it reaches a decided rose tint bordering on purple; after which, it rapidly deteriorates in sensibility. The light, even of a candle, should not be allowed to fall direct while observing its colour, which should be done as quickly as possible, and in the same manner as described under *Iodizing the Plate.*

"It will often happen that the picture, when finished, appears as if it had a film over its surface; this can generally be avoided in the subsequent trials, by leaving the plate exposed to the bromine for the exact time you noticed was requisite to produce the proper colour in the first experiment, and the instant the time is expired, place it in the dark box, by which means you prevent the possibility of any light falling on its surface."

The author proceeds to describe how the prepared plate may be exposed to the focus of a refracting or reflecting camera—how the plate should be mercurialized—how the pic-

* Sometimes when the bromide is mixed with water, a precipitation of a black powder takes place; if this should happen, a few drops of the solution of bromine will restore its transparency.

ture should be fixed, &c., &c.; but as it would exceed the bounds of fair quotation to give the details of all the processes followed, we must refer the reader for those we have omitted, to the pamphlet itself.

LIST OF WORKS ON THE ARTS AND SCIENCES, PUBLISHED IN JUNE.

On the Nature of Thunder Storms, and on the Means of Protecting Buildings and Shipping against the Destructive Effects of Lightning. By W. Snow Harris, F.R.S., 8vo., with illustrations, 10s. 6d.

Productive Farming; or a Familiar Digest of the Recent Discoveries of Liebeg, Davy, and other Celebrated Writers on Vegetable Chemistry: showing how the results of English Tillage might be greatly augmented. By Joseph A. Smith, small 8vo., 3s. 6d.

Construction of Maps. Principles of Mathematical Geography; comprehending a Theoretical and Practical Explanation of the Construction of Maps, with Rules for the formation of the various kinds of Map Projections. By W. Hughes, F.R.G.S., Professor of Geography in the College for Civil Engineers, 8vo., with Plates and Diagrams. 6s.

An Essay on Spontaneous Combustion. By John Peto. 1s.

Photographic Manipulation, price 1s. 6d., containing simple and practical details of the most improved processes of Photogenic Drawing, Daguerreotype, and Calotype, illustrated with Cuts. Just published by E. Palmer, 103, Newgate-street, London, where may also he had all the apparatus and chemicals required for carrying out these interesting and valuable discoveries.

The Progress of the Nation, in its various Social and Economical Relations, from the beginning of the Nineteenth Century to the Present Time. By G. R. Porter, Esq., F.R.S. Vol. III, containing Consumption, Accumulation, Moral Progress, and Colonies and Foreign Dependencies, in demy 8vo. cloth boards.

*** The Third Volume, now completed, furnishes some Supplementary Information to the preceding Volumes, previously published, with a complete Index.

Days at the Factories; or the Manufacturing Industry of Great Britain described, and illustrated by numerous Engravings of Machines and Processes. Series I:—London. By George Dodd. Post 8vo. 10s. cloth.

Smoky Rooms: the Causes and Cure. By E. Jukes. 3s.

A Steam Manual for the British Navy. By W. J. Williams, R.N., 12mo. 2s. 6d. cloth.

Glyphograph, or Engraved Drawing (Edward Palmer's patent), with Illustrations, and full Directions for the use of Artists, Engravers, and Amateurs, willing to avail themselves of this valuable invention, by which books may now be illustrated in the most finished style, securing to the artist a faithful copy of his work, and to the author or publisher a very great saving of expense, the drawings being transferred to surface printing blocks, which are printed like wood cuts, with the type. 1s. 6d.

Periodicals.

The London, Edinburgh, and Dublin Philosophical Magazine. By Sir David Brewster, Richard Taylor, F.S.A., Richard Phillips, F.R.S, and Robert Kane, M.D. Third Series. No. 147. 2s. 6d.

The Edinburgh New Philosophical Journal. Conducted by Professor Jameson. No. 69. 7s. 6d.

The Civil Engineer and Architect's Journal. No. 70. 1s. 6d.

Annals of Chemistry and Practical Pharmacy. No. 19.

The Pharmaceutical Journal and Transactions. Edited by Jacob Bell. No. XXIV. 1s.

The London Journal (Newton's). No. 138. 2s. 6d.

The Repertory of Patent Inventions. Enlarged series. No. 6.

The Artist's and Amateur's Magazine; a work devoted to the Interests of the Arts of Design and the Cultivation of Taste. Edited by E. V. Rippingille. No. 3.

The Practical Mechanics and Engineer's Magazine. (Glasgow.) Part 20. 8d.

The Builder. Part II.

LIST OF ENGLISH PATENTS GRANTED BETWEEN THE 30TH OF MAY, AND THE 21ST OF JUNE, 1843.

William Newton, of Chancery-lane, civil engineer, for certain improvements in obtaining copper from copper ores, some part, or parts of which improvements are applicable to obtaining certain other metals contained in same copper ores.—(Being a communication.) May 30; six months.

William Edward Newton, of Chancery-lane, C.E., for improvements in the method, or system, of constructing boats, and other vessels, which the inventor intends to denominate the "Mondotian System."—(Being a Communication.) May 30; six months.

John Tappan, of Fitzroy-square, Middlesex, gent., for certain improvements in apparatus applicable to flues or chimneys, for the purpose of increasing the draft therein, and promoting the combustion of fuel.—(Being a communication.) May 30; six months.

Thomas Forsyth, of Salford, Lancaster, engineer, for certain improvements in machinery for making bricks and tiles. June 1; six months.

Pierre Frederick Tugold, of Buckingham-place, Hanover-square, watchmaker, for improvements in machinery for making parts of watches and other time-keepers. June 1; six months.

Henry Fox Talbot, of Locock Abbey, Wilts, Esq., for improvements in photography. June 1; six months.

Martyn Roberts, of Carmarthen, Esq., for certain improvements in machinery for preparing, spinning, and winding wool, cotton, flax, silk, or any other fibrous bodies. June 1; six months.

Fennell Allman, of Salisbury-street, Strand, Surveyor, for certain improvements in apparatus for the production and diffusion of light. June 3; six months.

Junius Smith, of Fen-court, Fenchurch-street, London, gentleman, for improvements in machinery for sawing wood. June 3; six months.

William Brown, of Glasgow, merchant, for improvements in the manufacture of porcelain china, pottery, and earthenware, and which improvements are also in part applicable to the manufacture of paper, and to the preparation of certain pigments or painters' colours. June 3; six months.

Richard Farmer, upholder and cabinet-maker, and Joseph Pitt, plumber's brass-founder, both of Birmingham, for certain improvements applicable to fixed and portable water-closets, and beds or bedsteads, a part or parts of which improvements are also applicable to raising and forcing water. June 6; six months.

Robert Smart of the Commercial-road, Redcliff, Bristol, ship-owner, for improvements in paddle-wheels. June 8; six months.

John Burns Smith, of Salford, Lancaster, cotton spinner, for certain improvements in machinery for preparing, carding, roving, and spinning cotton, and other fibrous substances. June 8; six months.

Cartaret Priaulx Dobree, of Putney, Surrey, civil Engineer, for certain improvements in the manufacture of fuel. June 10; six months.

Henry Page, of Cambridge, painter, for certain

improvements in the mode of painting, graining, or decorating with oil, and other colours. June 10; six months.

Henry Austin, of 87, Hatton-garden, civil engineer, for a new method of gluing or cementing certain materials for building, and other purposes. June 10; six months.

Edward Joseph Francois Duclos de Boussois, of Clyne Wood Works, near Swansea, engineer, for improvements in the manufacture of lead, tin, tungsten, copper, and zink, from ores and slags, and other products, and in the manufacture of their alloys with other metals. June 10; six months.

Ernst Leutz, of Eastcheap, gentleman, for improvements in machinery for raising and forcing water, and other fluids, which machinery, when worked by steam or water, may be employed for driving machinery. (Being a communication.) June 10; six months.

Alfred Francis, of Vauxhall, Surrey, Roman cement manufacturer, and Isaac Funge, workman in the employ of the said Alfred Francis, for improvements in the manufacture of ornamental tiles. June 10; six months.

Samuel John Knight, of Water-side Iron Works, Maidstone, Kent, founder, for improvements in kilns or apparatus for drying hops, malt, and other substances. June 10; six months.

Thomas Wells Ingram, of Birmingham, engineer, for improvements in pressing and embossing wood, and other materials, in order to apply the same to various useful purposes. June 10; six months.

Samuel Sparkes of Wellington, Somerset, foreman at a woollen manufactory, for certain improvements in machinery for carding wool, cotton, and other fibrous materials. June 10; six months.

John Tappan, of Fitzroy-square, gentleman, for certain improvements in apparatus for grinding and polishing cutlery, and other articles, whereby the deleterious effects on the lungs and health of the workmen, produced by the dust and metallic particles arising from the said operations are entirely, or to a great extent, obviated. June 10; six months.

William Edward Newton, of Chancery-lane, civil engineer, for the novel application of certain volatile liquids for the production of light, and improvements in the lamps and burners to be employed for the combustion of such or other volatile liquids. (Being a communication.) June 10; six months.

John Galley Hartley, of Narrow-street, Limehouse, mast and block maker, for certain improvements in paving and covering streets, roads, or other ways. June 13; six months.

Frederick William Eggleston, of Derby, confectioner, for certain improvements in the combustion of fuel and consumption of smoke. June 15; six months.

Henry Bessemer, of Baxter House, Saint Pancras, engineer, for certain improvements in the manufacture of bronze, and other metallic powders. June 15; six months.

Prosper Antoine Payerne, of Paris, doctor of medicine, for certain improvements in keeping the air in mines and other confined places in a pure and respirable state. June 15; six months.

Thomas Johnson Irvine, of Peckham, lieutenant in Her Majesty's navy, for certain improvements in packing-cases, boxes, trunks, portmanteaus, and other articles for containing goods, which improvements may, under certain circumstances, be applied to the preservation of life. June 15; six months.

George Lister, of Dursley, Gloucester, card-manufacturer, and Edwin Budding, of the same place, machinist, for certain improvements in the means of covering the cylinders of carding and scribbling engines with wire card, and in condensing the rovings delivered from such engines, and also in apparatus for sharpening or grinding the points of the cards, which latter apparatus may also be employed for grinding other articles. June 15; six months.

Edward Hammond Bentall, of Heybridge, Essex, iron founder, for certain improvements in ploughs, and in apparatus which may be attached thereto, for ascertaining the draft of instruments employed in tilling land. June 15; six months.

George Bate, of Bloomsbury, Wolverhampton, Stafford, carpenter, for improvements in apparatus for raising and lowering window blinds and maps. June 15; six months.

James Gardner, of Banbury, Oxford, Ironmonger, for improvements in cutting hay, straw, and other vegetable matters for the food of animals. June 17; six months.

Samuel Brown, of Gravel-lane, Southwark, engineer, for improvements in the manufacture of casks and other vessels. June 17; six months.

James Mackenzie Bloxand, of Hampstead, esquire, for improvements on meridian instruments. June 20; six months.

John Read, of Regent-street, machinist, for certain improvements in ploughs for draining, subsoiling, and cultivating land. June 21; six months.

Railway Pneumatic Engine.—We had the pleasure the other day of seeing the operation of a new engine for propelling rail-road carts, vessels, &c., just constructed in this city by Mr. Levi Bissell, the inventor. It is, we believe, the first attempt claiming to be successful, to use compressed atmospheric air as a motive power. The engine, which is constructed for the purpose of testing the practicability of the principle, is about the size of a five-horse steam-engine, which it resembles externally, though its power is alleged to be much greater. A cylindrical iron chamber of the capacity of ten gallons is attached to the engine and filled with condensed air by a condensing pump. The air is conducted from this vessel to the working cylinder by a tube. Though the machinery, which is apparently very simple, is not yet entirely complete, it was put in operation twice while we were present, and certainly worked with great energy, until the power was exhausted. In order to bring this power into practical use on railways, Mr. Bissell proposes to construct suitable pumps at convenient distances on the line of travel, with reservoirs capable of sustaining air condensed to 2,000 lbs. pressure to the square inch, from which the locomotive air-chambers are to be supplied. The condensing apparatus, it is also said, may be so constructed as to be portable, and thus accompany the engine as a tender. Among the supposed advantages of this contrivance over the steam-engine, the inventor alleges that the cost of the machinery will be much less, that it will be more durable, and far less exposed to derangements and accidents. The power, too, will be much less expensive, and at the same time more to be relied on. There are other advantages which, if the principle be practicable, will readily suggest themselves on a moment's reflection. — *Newark, U. S. paper.*

END OF VOLUME THIRTY EIGHT.

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